THE ELECTRICAL WORLD

A Weekly Review of Current Progress in Electricity and its Practical Applications

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Modern Dynamo-Electric Machines.—III.

The chief object to be sought in a dynamo-electric machine is the utilization of the magnetic field to the best possible advantage. Indeed, the desire to obtain a more complete concentration of the lines of magnetic force of the field magnets into the armature seems to be the point of departure of every invention that has created a new type of dynamo-electric machines. Some modifications which the magnetic field of the Gramme machine itself has met with at the hands of inventors are an interesting illustration of this fact. It is well known that in the Gramme machine only the outside portion of the armature passes near the pole pieces of the field magnets. It has always been questioned by some electricians whether the armature in this case derives as much benefit from its magnetic field as it would were it more entirely surrounded by the pole pieces. It is argued that the inside portions of the wire, not being useful in cutting lines of force act as so much idle resistance or dead weight to the electromotive force generated by the lines of force cut on the periphery of the armature. On the other hand, it is believed by others that were the field made to envelop the armature completely no more lines of force would be brought into play, but the same number would only be distributed less densely over the larger pole surface presented. Meanwhile, inventors have been modifying the magnetic field of the Gramme machine with the endeavor of answering the question in a practical manner, and some of these modified Gramme machines have been lately making their way to favor in Europe with much success. A brief notice of the characteristic features of these machines will be, no doubt, interesting and suggestive to electricians.

FIG. 4.

SCHWERD AND SCHARNWEBER.

In the machine of these inventors (Fig. 4), which formed an interesting feature of the Electrical Exhibition held at Munich last year, the poles of the magnetic field are reflected and prolonged inward so as to act on the inner portion of the armature. In the outward appearance of its magnetic field it recalls the Siemens machine (Electric Lighting XI.), this form of field magnet being in fact known by electricians as the "Siemens field."

The field magnets of the Siemens machines, however, are made of narrow pieces of wrought iron screwed side by side to the end pieces, and leaving slits between them for the purpose of localizing and obviating the induction of Faucault currents as much as possible. In the Schwerd and Scharnweber machine the field cores are of cast iron and in one piece, doubtless for the sake of cheapness and convenience of construction.

The novel feature of this magnetic field is of course the prolongations of the poles, by which the inside of the ring also is made to cut lines of force. These prolongations form an inward extension from the iron caps F bolted to the poles. One of these prolongations is seen at A in the figure. The inner surface of the amature revolves very closely to the outer surface of each prolongation, which forms a portion of a circle, and thus the wire inside the ring is acted upon by whatever magnetism there may be present there.

The armature is cylindrical in shape and wound in the same manner as the Gramme ring. It is fastened to the axis at its centre. The polar prolongations extending inward from each side, leave a space at the centre, in which a metallic "spider" carried by the shaft can move. The armature is secured to the spokes of this spider, which expand at their outer extremity, and are fitted to the armature core at its centre, a space being left between the sections of wire for the purpose.

C. O. M.

The Influence of Temperature on the Current of Voltaic Batteries.

Mr. W. H. Preece, the well-known English electrician, has lately communicated to the Royal Society some interesting observations on the above subject. It had long been known that the current evolved in voltaic batteries is subject to certain variations as the temperature of the exciting solutions change, a rise in temperature being ordinarily followed by a corresponding increase of current. This phenomenon was first noted in 1840 by De la Rive, and it has since been observed in turn by Faraday, Daniell, Crova, Becquerel, Kohlrausch and many others. The exact rôle which the heat plays in causing this peculiar result does not seem to have been thoroughly understood by these physicists, however, because the opinions and explanations offered by each of them to account for the variation do not coincide fully. Thus De la Rive and Daniell ascribed the phenomenon to an increase or acceleration of chemical action resulting from the enhanced chemical affinity produced by heat, while Faraday attributed the result to a simple increase of electrical conductivity of the liquid, and showed that the effect was not due either to movement or chemical action, or thermo-electric action, or even to an increase of electromotive force.

The observations of Becquerel and others also showed that the internal resistance of a voltaic cell invariably diminishes when the temperature of the cell rises. This accords with the recognized fact that all liquids which conduct electricity by becoming decomposed, that is to say those liquids which are *electrolytes*, experience a decrease of resistance as their temperature rises. This reduction of the internal resistance would of course suffice to account for the increased production of current, because it serves to reduce the divisor R in the formula $\frac{E}{R} = C$, which is the expression of Ohm's law.

Thus representing by r the loss of resistance at any temperature the formula would be $\frac{E}{R-r} = C$.

In other words, assuming that the electromotive force (E) of our battery, when cold, is 1 volt and its resistance (R) 3 ohms, the current through a short circuit of no resistance is $\frac{1}{3} = \frac{1}{3}$ ampère, but if the internal resistance becomes diminished by a certain amount (r), say one ohm, then we have $\frac{1}{3-1} = \frac{1}{2} = \frac{1}{2}$ ampère, showing an increase of $\frac{1}{6}$ ampère. This is on the assumption that the electromotive force (E) remains constant. Such is not always the case, however. Crova has studied the effects of heat with respect to the electromotive force alone, and he has found that it gives rise to important variations. He observed that the electromotive force of a Daniell battery decreases in regular ratio as the temperature rises. With the Grove battery, on the other hand, he found that the electromotive force increased with the temperature, while with a single liquid battery of the Smee type the electromotive force was independent of the temperature. Mr. Latimer Clark also showed that the electromotive force of his standard battery varied inversely with the temperature at the rate of .06 per degree Centigrade.

It follows, therefore, that the formulas given above would apply only to single liquid batteries. For the Daniell battery a certain value e would need to be subtracted from the electromotive force, while for the Grove battery a corresponding value would have to be added. The formula would then be $\frac{E-e}{R-r} = C$ in the case of the Daniell battery, or, replacing e by .05, or any number for convenience, the arbitrary case above given would be altered as follows: $\frac{1-.05}{3-1} = \frac{.95}{2} = .475$ ampère. Assuming the same figures in the case of the Grove battery, for convenience, the result would be

$$\frac{E+e}{R-r} = \frac{1+.06}{3-1} = \frac{1.06}{2} = .53 \text{ ampère.}$$

It is evident from the last two formulas that in order to analyze the variation of current resulting in a voltaic battery with changes of temperature we must study separately the electromotive force and the internal resistance in each case, and this is what all previous observers have failed to do, because their observations only note the effects produced on one of these factors. The experiments of Mr. Pierce were undertaken with the special object of studying these two causes of variations separately in a systematic manner and for the purpose of furnishing definite or exact measurements and data for purposes of comparison.

The battery cell was placed inside a copper vessel filled with water and provided with a cover, having four openings, two of which were insulated from the rest and served for the passage of the conductors, the other two serving to admit the thermometer into the liquid or liquids within the vessel without necessitating the raising of the cover. The water in the vase was heated by the flame of a gas-burner placed beneath, and the electromotive force and internal resistance of the element contained in the vase were determined at different degrees of temperature. The batteries tried were the Daniell, the bichromate of potash battery and the Leclanché battery—that is to say, the three types most frequently employed in telegraphy. The Daniell battery used consisted of a cylinder of zinc (not amalgamated) placed in an earthen vessel containing a solution of sulphate of zinc, a porou

cup containing a cylinder of copper in a solution of sulphate of copper being placed inside the zinc cylinder. Two forms of bichromate batteries were used, one being the well-known single-liquid or Grenet battery, and the other the double-liquid arrangement known as the Fuller battery.

In this battery the positive plate is of carbon placed in the bichromate of potash solution and the negative element is composed of a block of zinc in the shape of a pyramid attached to a copper wire. This zinc element is amalgamated and placed on the bottom of a porous vessel containing a solution of dilute sulphuric acid. The Leclanché is of the ordinary porous cup type, and needs no description.

The method adopted by Mr. Preece for measuring the electromotive force and the resistance of the above cells was not only simple, but was free from all errors due to polarization, and may be regarded as exact. This method, which was originally devised by Mr. Kempe and modified by Mr. Munro, depends on the charge and discharge of a small condenser through a galvanometer of comparatively low resistance. This may be considered an exact measure of the electromotive force present, since the current is practically instantaneous, and the whole current present acts upon the galvanometer needle.

The accompanying figure shows the precise arrangement of this apparatus. C is a small condenser of $\frac{1}{3}$ microfarad capacity; G is a sensitive reflection galvanometer, b is the battery whose constants are to be measured, r is a derived circuit of low resistance and K, K_2 are contact keys. The condenser is first charged by means of a standard Daniell cell placed at b, and the deflection D of the galvanometer during the charge is noted. The standard cell is replaced by the battery b to be measured. On pressing the contact key K the deflection indicates a deviation, of charge d in the condenser; keeping K depressed K_2 is now depressed so as to make the resistance r a derived circuit of the battery b, by which the electromotive force acting on the condenser is reduced, and a deviation d' in the opposite direction is the result. From these data the electromotive force and internal resistance may be easily obtained. For the electromotive force, let E represent the electromotive force of the standard and e the electromotive force to be measured, then the two deflections D and d give us the following formula: $e = E\frac{d}{D}$.

For the internal resistance let b represent the value sought, then from r the resistance of the derivation and the deflections d d', we have

$$b = r\frac{d'}{d-d'}.$$

The tests were made at various temperatures, ranging from zero to 100° Centigrade, the heat being discontinued at certain intervals, and the temperature allowed to fall. In some cases the cooling was aided by the application of ice to the copper vessel. The degree of saturation of the solution was also varied in the case of the Daniell battery.

The results of these important observations are collated in interesting tables and represented by curves which we cannot here reproduce, but we will give an abstract of the conclusions to which they lead.

THE DANIELL BATTERY.

Variation of Electromotive Force.—As the temperature passes from a low to a higher point until it reaches the upper extreme (about 100° C.), the electromotive force lowers at first rapidly, but afterward more slowly, until at a certain point it begins to rise, and continues to do so until the boiling temperature is reached. A singular thing, however, is that the electromotive force remains constant, or nearly so, as the temperature is permitted to fall from 100°.

It is a noteworthy circumstance in this connection, that while the liquids are being heated, the temperature of the sulphate of zinc rises faster than that of the copper sulphate, and that on cooling it also falls faster. These facts tend to show that the weakening of electromotive force was due in part, if not altogether, to a thermo-electric action produced in the circuit.

Variations of Internal Resistance.—The following conclusions are clearly shown by the experiments:

1st. When a Daniell element is heated from a low temperature, say from zero Centigrade, to a high temperature, say 100° C., the resistance makes a sudden fall at first and then diminishes more gradually afterward. 2d. When the heated cell is cooled the resistance increases, but in greater proportion than it diminishes while being heated; in other words, the resistance of a Daniell cell at any given temperature (at least between 0° and 100° C.) is lower before the cell has been raised to a higher temperature than after, provided that the warming and cooling do not take place too slowly. 3d. If the cooled cell is left to itself at a given temperature the resistance of that element diminishes more and more until finally after a certain time of from forty to fifty hours it returns to the same value that it had before it was heated. 4th. The resistance of a Daniell element is much lower when the sulphate of copper solution is more concentrated than when it is less concentrated, whatever may be the temperature, other things being equal.

THE BICHROMATE BATTERY.

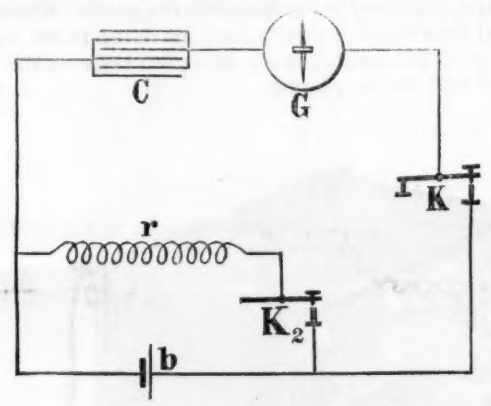
Variations of Electromotive Force.—The electromotive force of both forms of this battery diminishes regularly as the temperature rises more and more, and increases as the temperature falls. The regular decrease of electromotive force for the rise of the temperature and its increase by the fall of temperature (at least, between the limits of 0° and 100° C.) were greater in the case of the single liquid or Grenet than for the Fuller battery. In the first case the electromotive force at 100° C. was 6 per cent. below the value it had at 14° C., while in the second case the electromotive force at 100° C. was only about 1.6 per cent. below its value at 19° C.

Variations of Internal Resistance.—The rise of temperature caused a decrease of the internal resistance and the fall of temperature an increase of resistance, but the discrepancy noticed in the second conclusion regarding the Daniell cell between the resistance obtained at any given temperature while the cell was being warmed and the resistance obtained while the cell was cooling was scarcely apparent, and could be attributed to errors of observations. What little of difference appeared in this case between the resistance of heating and of cooling indicated an opposite tendency; in other words, the resistance was slightly greater at any temperature before the cell had been heated than while it was falling to that temperature from a higher one by cooling.

THE LECLANCHÉ BATTERY.

Variations of Electromotive Force.—The experiments showed that the electromotive force of this battery varied with the temperature in such extremely small proportions that the variation could be detected by the method used only with the greatest difficulty. The electromotive force may therefore be considered constant at all temperatures.

Variations of Internal Resistance.—The internal resistance of the Leclanché battery varies with the temperature in nearly the same manner as the bichromate battery, and in this case also the coincidence between the resistance before and that after heating for any given degree is so nearly exact that the same doubt exists as to whether the slight difference is not due to errors of observation and measurement.



The general conclusion drawn from these important results by Mr. Preece is that changes of temperature do not practically effect electromotive forces in voltaic batteries, but influence materially their internal resistance, and that in this respect the observation of Faraday is fully confirmed. Mr. Preece submits further that among the different forms of batteries in use, the Daniell cell is the most strongly influenced by changes of temperature, and that in all the experiments made with this battery, its temperature should be maintained constant, or else its internal resistance should be frequently measured and the variations taken into consideration.

Progress of the Edison Companies.

We have received the nineteenth bulletin of the Edison Electric Light Company, issued by President Eaton to the stockholders, for the purpose of giving them information concerning the progress of the company. It is dated August 15, 1883.

The plant in the first district, this city, is now in its twelfth month of continuous operation, and now lights 431 houses, wired for about 10,300 lamps.

A plant of one L dynamo, with a capacity of 150 lamps, has been installed on Mr. Jay Gould's new yacht "Atalanta." The company is installing a plant on the ferry-boat "Fanwood" of the Central Railroad of New Jersey; another in the show room and music hall of Messrs. Chickering & Sons, Boston; in the New Bedford Cordage Company, New Bedford, Mass.; in the building of the *Times*, Pittsburgh, Pa.; hotel, Lake George, N. Y.; cotton mill at Augusta, Ga.; steamer "Clan Mc Intosh," of the Clan Line; on the U. S. Steamship "Trenton;" on the steamer "Kinan," running between San Francisco and the Sandwich Islands; on the steamer Alaskian, of the Oregon Railway and Navigation Company; flour mill, Buffalo, N. Y.; cotton mill at Atlanta, Ga., and two others at Augusta; printing house, Baltimore, Md.; boat Kalama, of the Northern Pacific Railroad; Belmont Pumping station of the Philadelphia Water-Works; building of the *Daily Press and Knickerbocker*, Albany, N. Y.; grain elevator, Buffalo, N. Y.; steamer Adelaide, of the Australian Steamship Company; two cotton mills, Fall River, Mass.; the Louisville Exposition. The Western Edison Light Company has sold plants to a dry goods establishment in Chicago and to a flour mill firm in Milwaukee.

In Santiago, Chili, there are four hotels in the district lighted, and a series of fire alarms is being introduced in each of them. In addition to the lamp or lamps used to light the bedrooms, another lamp has been placed near the ceiling of each room, so as to be out of reach of the occupants, while other lamps are arranged in the halls and at the exits. Electric bells are placed in the halls. The whole of these lamps and bells are embraced in one circuit which terminates in a switch placed in a recess in the wall in some conspicuous place. This recess is covered by a pane of glass to protect the switch from careless or malicious use. In case of a fire breaking out in the hotel this pane of glass is to be broken and the switch closed, thereby lighting all the lamps and ringing the bells. By this device, therefore, the guest is not only apprised of the danger, but is provided with sufficient light by which to escape. The cost of installation is small, and the working expenses trifling, while the arrangement is so simple that nothing can ever get out of order.

Under the title of the "German Edison Company for Applied Electricity," a company has been organized to extend the Edison system of lighting throughout the whole of Germany. Installations have been made in the following foreign cities: Theatre, London, Eng.; theatre, Prague; brewery, Munich; paper factory, Cöswig, Germany; man-of-war, Trieste, Austria; arsenal, Spain; theatre and restaurant, Berlin; factory, Neuwied, Germany; exposition, Caen; café, Cognac; factory, Annonay; hotel, Eaux-Bonnes; paper factory, Voiron; woolen mill, Roubaix, France; bonded warehouse, Paris; paper factory, Rives; oil factory, Bordeaux; government offices, New Zealand; House of Assembly, Melbourne, Australia; government buildings, Brisbane, Queensland.

Underground Electrical Communication.

In previous issues we published accounts of the organization by the electric companies of this city of a committee on underground communication.

The following "explanatory notes" from the sub-committee on Electrical and Mechanical Devices define the points to be taken into consideration by inventors engaged in studying the subject:

"It is required that the conductors or wires of the telephone system, of the several different systems of telegraphic communication, and of the several systems of arc and incandescent electric lighting (systems greatly varying in electromotive force used, and in character and strength of current), be laid in a single conduit, or way, and—what is absolutely essential—in a manner so as to be inductively independent of each other and practically free from retardation.

"As an example of the necessity of securing freedom from induction and retardation, the telephone may be cited. Being extremely sensitive, it responds to electrical impulses of many thousands in a second, and it is essential that no substantial modification of the electrical impulses shall take place during transmission. As induction varies inversely as the square of the distance, it is evident that the necessary proximity of a large number of telephone, telegraph and electric light wires in a single underground conduit would very greatly increase the existing annoying interference from induction, not only from the telegraph and electric light wire, but from other telephone wires. With any considerable length of wires comes retardation due to increased electrical capacity, and, as is well known, an enormous increase of capacity results when an insulated wire is placed underground. Retardation not only delays, but modifies and distorts the signals. The sound produced by the voice must preserve certain and great rapidity of change, and when retardation is so great that signals cannot be transmitted with this necessary rapidity, then said sounds are so imperfectly reproduced as to become partially or wholly unintelligible.

"The Holmes Burglar Alarm Telegraph, central office system, is based upon the use of a continuous current of constant quantity and intensity, in connection with a delicately-constructed galvanometer. Any deflection of its needle, caused by induction destroying the constancy or changing the intensity of the current, gives a false alarm, and thus induction destroys the entire system.

"The character of the service of the Time Telegraph Co., at present employing a metallic current, exacts perfectness of operation, and is such that occasional failure of working, except at very long intervals, would be fatal to its usefulness and its existence. In consequence, freedom from breakage, leakage, heavy induction, defects in insulation and ground connection is absolutely essential.

"The particular requirement of the District Telegraph (messenger service) is facility for making connection with every house without disturbing the pavement. Metallic circuits are employed of a length not exceeding one or two miles.

"These will serve as illustrations.

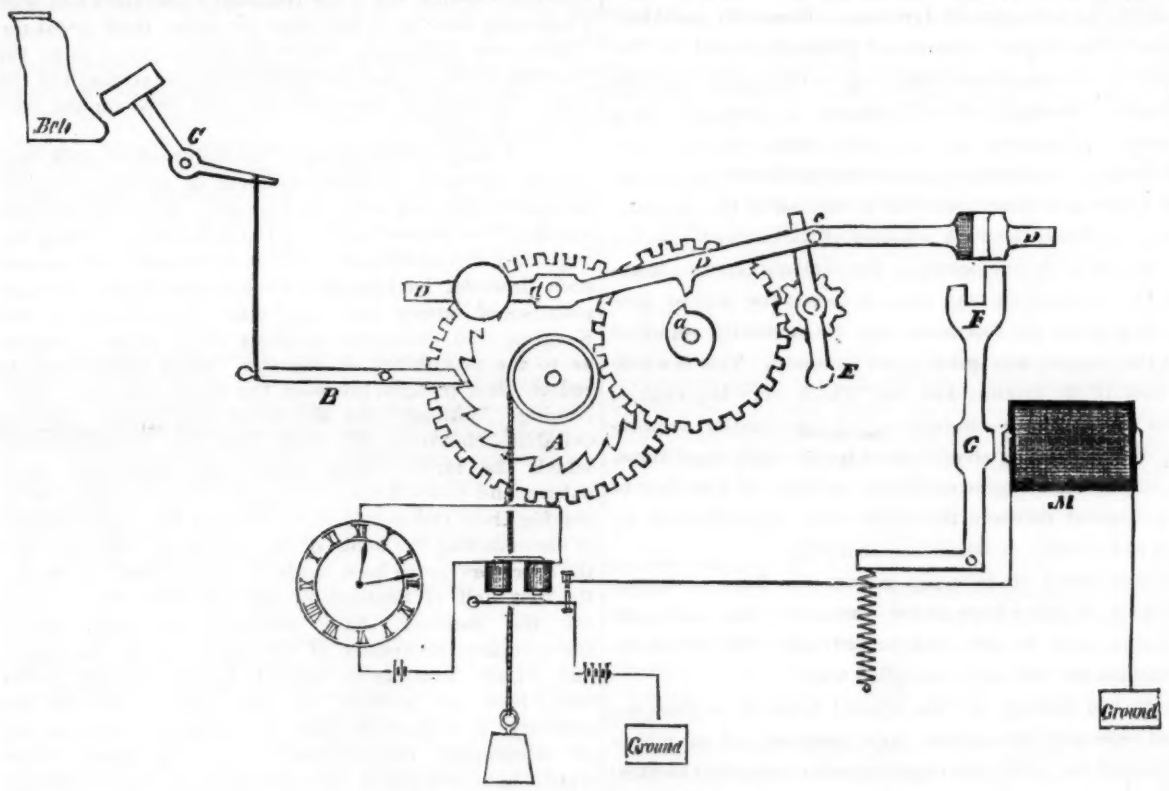
"The conduit or electric way must be of large capacity—say from 2,000 to 5,000 wires—and of a practicable form and size in cross-section. If naked wires are employed, moisture must be excluded from them and from all connections. If insulated wires are used, the character of the insulation will determine the necessity of exclusion of moisture. The details of construction must be such as to permit, without removal of the pavement, immediate con-

nection, or repeated changes with every house or building for all kinds of electrical service, access for repairs and testing, and the laying of additional wires and their removal."

Electrical Striking Clock.

BY J. W. LATTIG.

A complete description is given below of the striking clock recently placed in the tower of the St. Mark's Episcopal Church, of Mauch Chunk, Penn. The striker proper consists of a cast-iron stand and frame upon which is placed the wheel train that operates the hammer. There are three shafts and gearings; the largest shaft carries a drum upon which is wound a wire rope running from thence through double blocks at the ceiling and through a single block at the weight. This shaft also has at one end a wheel *A* having twenty cams at regular intervals, which engage with the short end of the lever *B*, the long end being attached by a wire rope to the tail of the hammer *C*, which is about 30 feet above. The hammer when at rest is always poised, ready to descend immediately upon the starting of the machine. The intermediate shaft, besides assisting to regulate the speed and power of the train, is provided at one end with a double cammed wheel *a*, just beneath the escapement lever *D*. This lever has a laterally projecting stud on its inner side at *c*. The third and smallest shaft is arranged, at one end, with an arm *E* rigidly affixed thereto, and having upon one extremity a right angled projection adjusted to engage with the stud *c* of the escapement lever *D* when the latter rests upon the upper prong *F* of the U shaped armature *G*. At the other end of the shaft bearing the arm *E* a larger arm with brass plates or fans joined to each of its ends is attached to the shaft by ratchet and spring and is, consequently, able to fly freely in the direction of the motion of the



ELECTRICAL STRIKING CLOCK.

machine after the latter has come to rest, thus serving to relieve the strain upon the machine by sudden stoppage. The fans are desirable to regulate or govern the speed of the instrument.

The escapement referred to above weighs about four pounds, is pivoted at *d* about two feet from the electro magnet *M*, and drops of its own weight, when freed, upon the top of the armature *G*, where it rests when the machine is quiet. This armature stands similarly to that of an ordinary relay except that the top is U-shaped, as shown by the prongs standing in a line with the helices of the magnet and one prong being longer than the other. The escapement lever *D* rests upon the longer prong until the armature *G* is attracted, when it drops to the second prong, falling from the latter when the armature recedes, the object of this double drop being to prevent the machine from running away should the circuit closing points fail to break contact immediately after closing.

The clock is an ordinary eight-day striking clock, with pendulum, of the Seth Thomas Company's make, but instead of the usual striking apparatus is arranged with a circuit closing device. One jar of a prism battery is connected through the clock and to the magnets of an ordinary repeating sounder, the object of using the sounder being to prevent the oxidation of the points in the clock, which would be more marked from a heavy battery, and which are somewhat difficult of access for cleaning. The repeating points of the sounder, the electro-magnet *M* of the striker and four jars of prism batteries are included in the circuit to the church tower, where the striker is located.

The complete action is as follows: At each hour the clock closes the circuit as many times as the hour of the day may require, but only once every five seconds, thus allowing the machinery time to regain after each stroke. Upon each contact the sounder closes, completing through its repeating points the circuit to the tower, the electro-magnet *M* of the striker is energized and the armature *G* is attracted, allowing the escapement lever *D* to fall from the long to the short prong, but as the circuit is instantly broken again the armature recedes and the lever completes its fall to the centre of the yoke of the armature. When the drop of the lever is finished the right-angled projection of the arm *E* clears the stud at *c* on the lever *D*, liberating the machine, and as it starts the cam of the large shaft *A* is disengaged from the lever *B*, that holds the hammer suspended, and by its own weight the hammer falls, striking the bell one blow. The double cammed wheel *a* of the second shaft then makes half a revolution, raising the escapement until the stud *c* again engages with the stop arm *E* of the third shaft, and the instrument comes to rest. The same operation is repeated until the proper number has been sounded.

The machine was made by the Seth Thomas Clock Company, of Thomaston, Conn., and is marked Number 1, it being so far as known the first in the United States used for the purpose of a town clock. The weight that moves the train would probably tip the beam at one thousand pounds; it falls one-half an inch at each blow of the hammer and is wound up twice a week. The clock is located in the office of the Lehigh Valley Railroad Company, and is never allowed to vary more than ten seconds.

The American Electrical Works Clam Bake.

The fifth annual clam bake given by the American Electrical Works of Providence to representatives of the telegraph, telephone and electric light business, took place on Saturday last, as announced in last issue of THE ELECTRICAL WORLD, and like the four that had preceded it, was a brilliant success. Electricians from all parts of the country were present to enjoy a pleasant holiday and participate in a genuine Rhode Island clam bake. Several prominent local non-electrical celebrities—including ex-Gov. Lippitt and ex-Mayor Doyle—also graced the occasion by their presence. Mr. Eugene F. Phillips, president of the American Electrical Works, who has given one of these enjoyable clam bakes to his electrical friends every year since 1879, is never happier than he is at such a time, Supt. W. H. Sawyer and Mr. J. O. Darling also enter into the matter with so much enthusiasm that success follows as a matter of course. We regret that we were unable to be present at this year's bake, but we learn from the Providence *Journal* that the guests, of whom there were about 75, were welcomed at the grounds by Mr. Phillips, the host, in his usual cordial manner. Among the electricians present were Messrs. Henry W. Pope, M. W. Goodyear, I. A. Sherman and G. M. Robeson, New York; E. V. Cherry, vice-president of the Standard Electrical Works, Cincinnati, O.; J. H. Lounsbury, Hartford; H. C. Haskins, Milwaukee; S. M. Cortright, Harrisburg, Pa.; E. B. Baker, New Haven; Abner Coleman, Taunton, Mass.; James H. Cary, H. B. Lytle, Geo. W. Adams, W. D. McKinney, J. J. Carty, Emile Berliner and George W. Pierce, Boston; A. C. Newcomb, Springfield; Stephen M. Canty, Baltimore, Md.; E. M. Wilson, Worcester; W. K. Wagner, New Bedford; J. Jepson, Putnam, Conn.; W. S. Crofut, Walpole, Mass.; M. G. Barker, Lowell; C. M. Rhodes and J. W. Pierce, Taunton; and L. N. Keller, Texas.

Each gentleman was presented with a badge of unique design, consisting of a clam shell suspended from a silver pin, with a crimson ribbon bearing a small bannerette in black on which were the words, "American Electrical Works, Fifth Annual Bake, Providence, R. I.," in gold letters. The time was spent in kicking foot ball, archery, etc., continues the *Journal*, until 1 o'clock, when the gong was sounded and the guests took their places at the table in the neat dining hall, to partake of a tempting luncheon. Mr. Phillips made a pleasing address of welcome, and concluded by calling on ex-Governor Henry Lippitt, who made a few humorous remarks, after which full justice was done to the ample spread.

The electricians, when the inner man had been satisfied, deserted the tables for the grounds, where the sports of the afternoon, consisting of foot-ball, wheelbarrow races, base-ball, shooting, etc., were entered into with characteristic spirit and zest.

The dining-hall was again filled about 4 o'clock, when the regular clam dinner was served. Before proceeding to the discussion of the enticing clam and its concomitants, Mr. Phillips called the guests to order, and introduced the Hon. Thomas A. Doyle, who was received by a burst of applause from every part of the hall. Mr. Doyle's remarks were in his most pleasing vein, and though necessarily brief, were to the point. When he had concluded he was again cheered heartily, and then all fell to with a will, and the way the shells began to loom up on the tables was enough to satisfy every one that the visitors were apt pupils in learning the intricacies of little Rhody's great institution, the clam-bake. After the dessert the party again repaired to the grounds, where the sports were continued. Clay pigeon shooting was now the favorite amusement, and after several gentlemen had taken a hand, Mr. Geo. W. Gardner, of Providence, was declared the most successful marksman. A pleasant feature of the afternoon was the excellent singing of Mr. Levi Burdon, which attracted no little attention, and was the source of much pleasure to the large group, who listened with evident delight to his vocal selections. Wearied with out-of-door exercise, the boys assembled in the club-house, and here the merriment was continued. Here the story-teller held sway, while the poet, in the person of Mr. James H. Cary, of Boston, had a goodly number of followers. The orator, too, made his voice heard, and after some well-rounded periods of rhetorical flight, the walls rang with the loud demonstrations of approval. At 7:15, the What Cheer arrived, and the party returned to Providence, where they were taken in charge by Capt. R. C. Brown and escorted to the station of the Rhode Island Electric Light Company, on Dyer street, which was thoroughly inspected. The party then separated, many leaving the city on the late trains, while others remained the guests of friends in the city. Every one emphatically declaring that the fifth annual bake of the American Electrical Works was as successful and enjoyable as any given in former years.

The Electric Railway.

Mechanics of this city republishes our article on the Electric Railway at the Chicago Exposition, and in commenting on it says:

In another column we give a plain and intelligible account of the construction and method of working of the electric railway at the Chicago Exposition. This, although put up with a haste which was astonishing and in the face of very many serious difficulties, worked successfully, and during the exposition carried nearly 27,000 passengers. It made a total of 1,588 trips during the two weeks of its running, from June 9 to June 23. There were several features, notably that of varying the speed of the motor, which were new, and the whole apparatus, in spite of its crudeness, gave promise of a successful application of electricity to locomotive work in the future. The application of electric currents to driving motors seems to be capable of being developed to a much greater degree than it has heretofore been thought possible. Since the difficulties of insulating the track and forming a locomotive connection with the central conductor have been overcome, we see no reason why the electric railway may not take its place profitably in many locations, especially where water-power is obtainable.

The Western Union's Ironclad Pledge.

The following is what the Western Union compels those it gives employment to to sign:

WESTERN UNION TELEGRAPH COMPANY.

AGREEMENT WITH RE-EMPLOYED TELEGRAPHERS.

I ..... of ....., in consideration of my present re-employment by the Western Union Telegraph Company, hereby promise and agree to and with said company that I will forthwith abandon any and all membership, connection or affiliation with any organization or society, whether secret or open, which in any wise attempt to regulate the conditions of my service, or the payment therefor, while in the employment now undertaken. And I do hereby further agree that I will, while in the employ of said company, render good and faithful service to the best of my ability, and will not in any wise renew or re-enter upon any relation or membership whatsoever in or with any such organization or society.

Dated.....

Signed.....

Address.....

Accepted for the Western Union Telegraph Company,

.....

Superintendent.

THE
ELECTRICAL WORLD,

PUBLISHED WEEKLY AT

No. 9 MURRAY STREET, NEW YORK.

W. J. JOHNSTON, Editor and Publisher.

NEW YORK, AUGUST 25, 1883.

CONTENTS.

ILLUSTRATED ARTICLES: PAGE.
Modern Dynamo-Electric Machines....531
Electrical Striking Clock....533

EDITORIAL:
The Steam Engine in Electric Lighting....534
End of the Strike....534
The Genesis and Value of Consolidation....534
The Index to Volume I....535
Manufacturing Accumulators....535
A New Kind of Storage Battery....535

MISCELLANEOUS:
Progress of the Edison Companies....532
Underground Electrical Communication....532
The American Electrical Works Clam Bake....533
The Electric Railway....533
The Western Union's Iron-Clad Pledge....533
The Human Body as a Conductor....535

DEPARTMENTS:
The Telegraph....536
The Telephone....536
The Electric Light....537
Miscellaneous Notes....537
Department of Inquiries....537
Electrical Patents Issued....538
Business Notices....538

NEW ADVERTISEMENTS.

Charles L. Bly.—Electric Light Supplies, Annunciators, and all kinds of Electrical Instruments....542
Curt W. Meyer.—Educational Electrical Apparatus and Supplies....546

THE STEAM ENGINE IN ELECTRIC LIGHTING.

The influence which electric lighting has begun to exert within a few years on the design and construction of steam engines is an interesting example of the well-known fact that progress in one branch of industrial science tends to stimulate a reciprocal advance in the collateral branches. The electric light had scarcely made its first steps onward at the beginning of its career before the desirability of certain qualities in the steam engines used in providing the required motive power was revealed. Gradually the conviction dawned upon the electrical engineer that the duties to be performed by the engine called for requirements of such importance that they could only be met by a special design adapted to the case. The result has been the creation of new types of steam engines, which in a measure represent a new phase of evolution, just as did the marine engine and the locomotive engine. Much interest is at present taken in the design and construction of steam engines for driving dynamo-electric machinery. Indeed, we feel that with many the steam engine furnishing the power in an electric light installation is a subject of closer study and analysis than the rest of the plant. We are led to realize the importance which the steam engine has assumed in the minds of some electricians and electric light engineers by the correspondence which we frequently receive on the subject. A recent correspondent manifests his lively interest in the matter by censuring us in a friendly way because we fail at times to enter into full details regarding the steam engines used in various installations described in THE ELECTRICAL WORLD. This goes to show that there is a desire among those interested in electric lighting to make comparisons between the different types already in the field, for the purpose of making an intelligent selection as to which design is best adapted to this purpose.

The consideration of the requirements of steam engines for electric lighting is, therefore, among the most interesting and important of practical topics now before the electrical and mechanical engineer. The dynamo-electric machine is a gauge of exquisite sensitiveness which soon reveals the faults and imperfections in the steam engine used with it, and it requires persistent study sometimes to localize the defect and, it may be, still more to determine which is the best remedy for it.

Besides, the problem presents several questions to be answered. The tendency of the more recent practice is to dispense with countershafts and to belt the dynamo directly to the engine, or else to couple the armature to the engine shaft. This classifies the electric light engine among high speed engines, and here the list of requirements to be fulfilled is quite lengthy.

Rapidity of revolution necessitates a quick stroke, and the much-discussed question of the ratio between the length of stroke and diameter of cylinder comes up. Reciprocating parts must conform to the best practice, and since masses may be in a state of equilibrium while at rest but will not, of necessity, be in that condition when in motion, balancing should be done, in accordance with dynamical laws, or so that it will be perfect at the contemplated speed at which the engine is to be run.

In some instances the engine must be capable of long continued action, and then the problems connected with the journals, shaft, guides, etc., appear. Correct proportioning, discriminating judgment in selecting and applying materials in relation to the duties to be performed by them, nice adjustment, clean work and a careful selection of lubricants, in addition to good methods of lubricating, are a few of the items demanding close study. Economy in the use of steam and durability are as important in this work as elsewhere.

That part of the engine which is vital to success and takes precedence of all others is the governor, and it is here that the most puzzling difficulty is found. The load is variable, but the variations occur in a manner unknown before the introduction of dynamos. Generally speaking, the load of an engine is increased gradually; that is, the increase is not transferred instantly to the engine, but the mechanical resistance offered increases or decreases in a somewhat graduated manner, the strain yielding just sufficiently to enable the engine to take hold easily and adapt itself to the new conditions. But in the case of the dynamo-electric machine, the work required of the engine varies the very instant a change occurs in the external circuit. Moreover, the fluctuations may range between the widest limits. In a word, the full load may be instantly removed from the engine, and quickly put on again. This is a crucial test of an engine, and one which very few engines would survive, even not considering the ulterior requirement of maintaining steady speed under such conditions. The electric light engine evidently requires a governor of the extremest delicacy therefore, since it needs must respond to a change of conditions instantly.

Circumstances occasionally govern the kind of engine to be used, whether high or low pressure; but, although the design must be changed accordingly, the above requirements are still to be complied with.

There are already in use several types of engines designed especially for electric light purposes, all of which are claimed to fulfill the requirements of a perfect electric light motor more or less completely. It is too early to say how far they are successful. Experience must be permitted to render its verdict. It is probable that they all possess individual merits on which the favor they enjoy rests. It is to be hoped that electrical and mechanical engineers will not neglect to make a comparative study of all these types, as their experience enlarges, for it is in this manner that the factors can be found which will enable them to solve the problem in a complete and satisfactory manner.

End of the Strike.

At the time of publication last week the strike, as foreshadowed in that issue, was drawing near its end. Its death a few hours after is the leading event to chronicle in the present number. On Friday, the 17th inst., John Campbell sent a dispatch to Pittsburgh, which was forwarded from there to all the local assemblies of the Brotherhood throughout the United States, stating that the executive committee had come to the conclusion that the strike was a failure, and officially authorizing a return to their desks on the part of all striking operators willing to re-engage themselves to their former employers, and who might be able to do so. The effect of this communication was that a large portion of the striking operators applied for reinstatement in their old positions, of whom many were successful. All of these were received on the companies' terms, and those re-engaging with the Western Union were required to become parties to a written agreement binding them to resign their membership in the Brotherhood, and to promise not to join any organization attempting to dictate what wages the company should pay its employés. Those who had not succeeded in making a record rendering their re-engagement very desirable failed to accomplish it, as it was claimed that the operators who had succeeded them after the beginning of the strike had been found equal to the performance of their duties fairly well. This was particularly so in the cases of many young women, with consequences which were distressing to the applicants, until, with commendable gallantry, their brethren in the profession pledged themselves to maintain them until the necessity shall be outgrown.

Sentiment, as we all know, is often of great importance in adjusting the relations of disputants. No proof is needed that in the struggle just terminated, the strikers gained and the companies had to forego the advantage of intelligent public sympathy. We feel quite sure our readers will agree with us that a probable consequence of this will be that the companies will consider, and to some extent, at least, will act upon the knowledge that the people condemn them for necessitating the strike by their stinginess in the matter of remunerating their employés; that the widespread inconveniences of the strike were of their doing and not of the strikers; and will be convinced, moreover, that their policy lies in the direction of conciliating an improved opinion in the public mind by treating more fairly those whose skillful hands and ready intelligence are "the pulse of the machine" which makes contemporary the story of the national activities.

Throughout the struggle the Western Union Company assumed an attitude fairly characterized as defiant. Its capital, of course, commanded strong and able speech, keen business ability and the power to wait. Notwithstanding these advantages, its fight with former employés was not altogether a one-sided one. As contrasted with the representations made by him and others, his colleagues, during the continuance of the struggle, in which the strength of the strikers was haughtily pooh-poohed, Mr. Somerville's admission to a reporter that, as the contest had been decided, "he had no hesitancy in admitting that the ordering out of the company's operators had been a stunning blow to it, and that for some days great uneasiness was felt by the officers of the company as to the probable result," is more significant of the strength of the other side than of ingenuousness and truth on the part of the company.

One of the principal causes of the failure of the strike was that the operators were too confident of speedily winning the battle upon which they had entered. It was for this reason that they refused aid from the Knights of Labor at the beginning of the struggle. When, afterward, they needed such financial backing they were disappointed, although promises of money had been made in profusion by the Knights, who shared the sanguine views of the operators as to the probability of victory. When called upon to redeem their pledges, however, the money was not forthcoming. Without "the sinews of war" failure was inevitable. Moreover, the public took the inconveniences which the strike caused them with remarkable good nature, and relieved the companies of much business by making their communications through the mails instead of encumbering the hooks of the telegraph offices. Had the operators' move been made at a later date, say during the first half of September, when business men, away for the summer, have returned to their offices, the comparative apathy of the public as to the delays and other annoyances caused by it would hardly have been an incident of the strike, but, on the contrary, it is probable that the extraordinary necessity of telegraphic communication at the later season would have compelled the companies to make arrangements with the men out as speedily as possible. The younger and more enthusiastic of the operators seemed to be "spoiling for a strike," while the cooler heads of the leaders favored waiting a month or so longer, and were in a measure forced into a strike before they were really prepared. Added to this and the other causes we have indicated, were the facilities and wealth at the command of the companies, which enabled them, the time of the year favoring this policy, to quietly wait for the exhaustion of the movement.

The operators' strike of 1883 will be remembered as a plucky but untimely attempt to compel better terms from the companies which had employed them, but which might have succeeded had it been backed by sufficient capital, and had the time for making it been at a busier season of the year, in conformity with the wishes of the older and more sagacious members of the Brotherhood.

The Genesis and Value of Consolidation.

With regard to the stage of development attained in the public use of the telephone, two peculiarities cannot fail of observation by the most careless reader of the public prints. These are, first, the conflicting claims made as to the invention of the telephone itself, and, second, what is far more interesting to the public at large, the consolidation of telephone companies, already effected or about to be effected. In recent issues we mentioned some of the huge consolidations recently made, as that of all the companies in Iowa, and the later instance of those in New England; supplementing this with the judgment of a prominent man in Pittsburgh, that the companies in the great States of Pennsylvania and Ohio will shortly follow in taking the same course.

As has been demonstrated again and again, the consolidation of business interests formed for the purpose of rendering services to the public, as is the case in railroad

telegraph, telephone and certain other classes of companies, is an expression of their growth which may be characterized as natural. When, for example, leading business men in a city or community have formed themselves into, say a telephone company, combining their experience and capital with the view to augment their wealth by satisfying a public need, they are certainly apt to find in neighboring cities or communities other companies, formed for the same purpose. Obviously, the next step, upon comparison of the expenses involved, is the reflection that a further expansion of the principle of partnership, by the use of which each local company was formed, in the combination of companies already established, would insure economy in outlay, give opportunities of rest to those men desirous of retirement from executive positions, and provide the certain means of enlarged enterprise with the corresponding augmentation of profit; not to speak of the advantages to the public secured by the employment of the ablest officials, the purchase of the best machinery and other apparatus, and the growth of the service from place to place until the voice of Dan reaches unto that of Beersheba. To summarize these stages of development is to account for the consolidations of which we make note in the introductory paragraph, so far as the application of the general principle thereby involved and illustrated can be shown to account for them.

It is, moreover, to indicate in an indirect way the leading advantages accruing to the people at large by reason of consolidation. While consequences resulting from this may be in some cases open to criticism, they are incidental merely and do not detract from the value of consolidation as an expression of healthful development. Even the bugbear of "monopoly" is far from being an inevitable result of the process we have traced. Happily for the American community capitalists are numerous, and should consolidated companies fail to perform their obligations to the public, the opportunity to compete with them in business is not likely to be disregarded. Nor should it be overlooked that it lies within the power of the sovereign people to so shape legislation that the business sagacity or selfishness, as some would call it, of companies and corporations shall be so utilized as not to hinder but encourage private enterprise and at the same time and by the same means advance the public good.

The Index to Volume I.

Several subscribers have expressed the desire that the index of THE ELECTRICAL WORLD should be made out semi-annually. They say that they often require to turn back to examine articles on certain subjects in issues published several months before, and—in addition to the fact that fifty-two numbers of so large a paper make a rather unhandy volume to readily refer to—it would often save them much time and labor in finding what they want if they had an index every six months, instead of having to wait for one until the end of the year. They also point out that most weekly journals of the class of THE ELECTRICAL WORLD have two volumes a year, and while they know the preparation of two indexes would entail a little extra work in this office, they think subscribers will appreciate the convenience. As we are anxious to render the paper as valuable and the information it contains as easy of access to readers as possible, we have decided to gratify the wishes of these correspondents, and we to-day print, at the back of the reading matter, an index to Vol. I., which includes the months from January to August, inclusive. Vol. II. will be from the present time until the end of the year. After that there will be a new volume and a new index every six months.

Manufacturing Accumulators.

The Brush Electric Company, Cleveland, O., has added a new branch to its extensive manufactory, to be devoted to secondary batteries. The building to be used for this industry was designed by the superintendent of the company, Mr. Possons and cost $75,000. As great strength was required to sustain the massive loads to which it would be subjected the walls and floors are of unusual proportions, so that hurtful vibrations will not be possible. The walls are 20 inches thick and their strength is increased by pilasters projecting eight inches. The floor timbers are of I-beams which measure 15 inches and upon which are laid on edge, pine timbers two inches thick and six inches wide. These are securely bolted together and are covered with an oak floor 1¼ inches thick. This forms a solid mass of timber 7¼ inches thick. The roof is intended to carry a heavy line of shafting and was designed so as to be strong and stiff. The chimney stands in the centre of the building, but is entirely independent. It is 123 feet high and the flue, which is separate from the chimney, is 72 inches at the bottom, tapering to 70 inches at the top. Of the four engines needed in this department one has been finished and placed in position. It was made by the Cummer Engine Company, is 24 inches diameter by 48 inches stroke, and has an 18-foot fly wheel carrying a belt 44 inches wide. Steam is supplied by four boilers of 125 horse-power each. The shaft is six inches and the pulleys six feet in diameter. Each of the engines will run 10 dynamo-electric machines.

A New Kind of Storage Battery.

A veracious Kentucky newspaper reports that five fat hogs were lying under a shade tree recently, near Richmond, in that State, when the tree was struck by lightning. Instantly they rolled over on the broad of their backs and stuck their legs up as stiff as pokers. The owner sent a colored man out an hour afterward with a butcher knife to bleed them so the meat would not be spoiled. They were as rigid as if frozen, but as soon as the knife came in contact with the flesh there was a flash of fire along the blade, the negro severely shocked and the hog relieved from the spell. They appeared to be all right as soon as the electricity was drawn out of them, except that they were a little crazy for awhile and wanted to run off. This incident suggests a new use for American hogs, against which Germany has so cruelly closed her doors, and which may now be utilized for storage batteries. It also suggests a solution of the difficult problem which the Western Union Telegraph Company now has to face—what to do with all the "hams" it has accumulated, according to the newspapers, during the last month. If a hog will act as an electrical accumulator, why not a "ham?" As the "hams" are obviously unfit for any other use in connection with electricity, the discovery of the Kentucky pork-grower seems to be a most opportune one.

The Human Body as a Conductor.

In our issue of July 14 we republished the researches of Dr. W. H. Stone on the electrical resistance of the human body, and took occasion to comment upon them editorially, calling attention to several points apparently overlooked by the learned doctor, and which materially weakened the ground taken by him. Our contemporary the *Electrical Review* of London has recently published an interesting article on the application of electricity to medical purposes, in which are contained some valuable observations on the human body as a conductor, by Mr. A. de Watteville, M. A., B. Sc., author of the work, "Introduction to Medical Electricity." We are pleased to give place to these experiments in this issue, not only because they corroborate our own views in every particular, but because they convey some important knowledge on the subject which will be welcomed by all.

"*Experiment.*—Take a battery with galvanoscope in circuit, and choosing a convenient electromotive force (ten Leclanché cells answer the purpose very well), note the deflection of the needle obtained when two medium sized electrodes, moistened with cold water, applied to two given spots on one side of the body, 1st, at the moment of application; 2d, after the electrodes have been kept *in situ* for five minutes. The deflection in the latter case is greater, which means that the current is stronger because the resistance of the epidermis has been diminished by the moisture of the electrodes. Repeat the experiment on the symmetrical points of the other half of the body, with the electrodes soaked with hot salt and water. The deflection is greater at first, and soon reaches a greater maximum than before, because the penetration of the fluid into the skin is more complete and rapid. Note also the fact that the current is stronger when the electrodes are applied firmly to than when they are made to touch lightly the surface of the body.

"*Experiment.*—Take a pair of the different sized electrodes (fine, small, medium, large, very large), and apply them successfully to the same two spots with the same electromotive force (10 cells) in circuit. The galvanometric deflection increases with the size of the electrodes. Repeat the experiment taking the electrodes in the opposite order, so as to eliminate the fallacy arising from the increased moistening of the epidermis; and take care that, throughout, the electrodes be uniformly soaked. The skin forming the chief resistance of the circuit, every increase in the area it offers to the entrance of the current is accompanied with a considerable increase in the total current strength.

"*Experiment.*—Take two medium-sized electrodes and with 10 cells in circuit observe the deflections you obtain when they are applied to a number of symmetrical points on the face, neck, trunk and extremities. You will find that the deflections vary greatly. The experiment must be made carefully; the electrodes are to be moistened again each time they are applied and each time left *in situ* for a given number of seconds. That these differences are due chiefly to the varying skin-resistance can be demonstrated by repeating the experiment with needles thrust into the subjacent tissues (as is done in the treatment of rheumatism, paralysis, etc., by acupunction), and noting the deflections given with one or two cells in circuit.

"*Experiment.*—Apply a large plate electrode to the nape of the neck, and when the skin underneath it has been thoroughly soaked apply the other electrode (small or medium size) to a series of points along the trunk and limbs, taking the same precautions as in the former experiment; note the deflections obtained in each case. You will find that they vary not according to the distance between the electrodes, but according to the point touched with the movable one. The substitution of a needle for the latter, or the occurrence of superficial ulcers or excoriations, will serve to show that the variations observed depend upon different skin resistances at different points of the body.

"It is of great service in the electrization of the human body for diagnostic or therapeutic purposes, to be familiar with the relative resistance encountered by the current, at different points of its surface. Such a familiarity will speedily be obtained by systematically observing the deflection of the needle, under varying conditions of experimentation. Though a galvanoscope is sufficient to demonstrate the existence of great differences between the body resistances, the observer will be greatly assisted in realizing the facts by using a galvanometer divided into units of current strength, which allows him to compare these resistances with one another, and a rheostat, which enables him to measure them.

"Looked upon as a conductor of electricity, the human body may be compared to a vessel bounded with poorly conducting material (the skin) unequally packed with non-conducting solid particles, the interstices being filled up with a saline fluid of fair conductive power. The parts most densely packed with solid particles are represented by the bones; those where liquids predominate, by the muscles. Between the two are found the nerves, viscera, etc. The contents of the blood-vessels are the best conducting media in the body. In short, the list of the various tissues, arranged according to their watery constituents, may be considered as classifying them according to their electrical conductivity. The diffusion of electrical currents in such a conductor is evidently very irregular, and impossible to represent accurately, either by word or drawing. It has no specific resistance, nay, it is impossible to define accurately the specific resistance of any one of its component parts, whether nerve, bone or muscle, etc. The unequal distribution of blood among them, their complex structure (not to speak of their unequal internal polarization), makes any statement concerning their resistance subject to variations within wide limits.

"The chief resistance of the skin is located in the epidermis, which when dry is to be considered as an insulator. The epidermis, however, varies in thickness at different points of the body, and is not continuous, being perforated more or less thickly with the outlets of sweat-glands and follicles. Its resistance diminishes in proportion to the degree of its moisture (artificial soaking, perspiration). The increased vascularities of the underlying cutis has probably some influence in reducing the resistance of the integuments.

"The resistance of the skin varies accordingly to a prodigious extent, not only between different individuals and between different parts of the body of the same individual, but at the same points of the same individual under different conditions.

"Some minor points have to be taken into consideration with reference to the altered resistance of the epidermis, through its permeation with water. Hot salt water reduces the resistance more than pure cold water. The cataphorical property of the current, and perhaps also its influence on the cutaneous vessels, has the effect of reducing it still further than mere soaking. (The effect of a current on the deeper tissues—polarization—which is manifested on reversing it after it has flowed for a time, will be best considered along with its physiological effects.)

"A most important conclusion to be drawn from the fact that the skin, even under the most favorable circumstances, offers the chief resistance to the current, is that the size of the electrodes, that is to say, the extent of the body-surface offered to the current as spots of inlet and outlet, to a great extent determine the strength of the current obtainable for a given number of cells through the body. The resistance of a conductor, we know, varies inversely with its diameter; hence by doubling, trebling, etc., the size of the electrodes, we shall diminish the resistance of the skin 2, 3, etc., times. Now, since this resistance forms the greater part of the total resistance in the circuit, it is obvious that its diminution will be of great influence on the strength of the current. If we assume the resistance of the skin to be 100 times greater than that (R) of the rest of the circuit (battery, electrodes, internal tissues of body), the current strength, according to Ohm's law, will be given by the equation

$$\frac{E}{100\,R + R}$$

where E is the electromotive force in circuit.

"It is obvious that by diminishing the resistance of the skin by one-half, we shall increase the current in the proportion of 1 to 2 nearly for

$$\frac{\frac{E}{100\,R + R}}{2} : \frac{E}{100\,R + R} = 51 : 101.$$

These numbers are not meant to represent the facts, but merely to illustrate the principle involved in the problem.

"The above discussion may be conveniently summed up in the following statement.

"'The resistance of the human body' when put forth as a general statement is a meaningless expression. By it is to be understood chiefly the resistance of the two particular portions of the skin in contact with the electrodes under the conditions of the particular application: the resistance of the intermediate portion of muscle or other tissues (except bone) being almost negligible in comparison to the former, partly owing to the better conductivity of these tissues, partly to the large sectional surface they offer to the flow of the current. The resistances of the body will vary not so much according to the distance of the electrodes from one another, as according to their diameter, the

degree of moisture of the epidermis, its thickness at the point of application, the number of sweat ducts offered to the current, and the state of the cutaneous system, and to a certain degree, with the strength and length of the electrical application. Pressure on the electrodes diminishes the resistance.

"These considerations help to explain the prodigious discrepancies between the numbers ascribed by various observers, the resistance of the body.' The numbers given in every instance can apply only to the particular parts of the body of the particular individuals, tested under particular circumstances; when, therefore, we read or say that 2,000 or 3,000 ohms may be assumed to represent the average resistance of the parts of the body when galvanized with medium electrodes according to the polar method adopted in ordinary medical applications, no practical importance, except from the most general point of view, can be attached to statements of this kind, which are used for the purpose of argument and illustration only. Variations ranging between 1,000 and 10,000 ohms, are by no means rare under those very conditions."

It will be seen from these interesting experiments and the observations following them, how careful the medical practitioner should be in making electrical tests, and we feel more than ever convinced that our strictures on Dr. Stone's paper will meet with approval by the majority of medical men who find it necessary to employ electricity as a curative agent in many of the cases submitted to them. We should imagine that Mr. de Watteville does not hold the opinion that change of temperature is the cause of resistance variation in the human body, which certainly cannot be looked upon in the same light as a solid and metallic conductor.

THE TELEGRAPH.

THE GREAT NORTHERN TELEGRAPH COMPANY, London, has duplicated its cable from Wladiwostock to Nagaski. That from Nagaski to Shanghai is being duplicated by the same company.

AGAINST THE WESTERN UNION.—A rumor, not yet authenticated nor otherwise, says that the American Rapid, Bankers and Merchants', and Postal telegraph companies will consolidate, thus forming one gigantic competitor with the Western Union Company.

SUGGESTIVE ACCIDENT.—A telegraph pole fell in Philadelphia on Monday night, emphasizing the public wish that such dangerous accidents be prevented by placing all wires underground. Happily no person happened to be in the way of the falling pole, which was stopped in its fall by a church.

CALLING NAMES NOT ALLOWED.—On Wednesday two operators in the Western Union office at Albany, and one at the main office in this city, were discharged for calling operators "scabs" over the wires. The men thus telegraphically abused had not gone out with the strikers, and the abusers had. Hence the offense and the retribution.

MACKEY VS. GOULD.—The Boston *Herald*, referring to the establishment of the Postal Telegraph Company, says: "Mackey is richer than the telegraph operators were, so he can, if he chooses, fight Gould longer than they could; but he does not begin to be as rich as the Western Union autocrat, so the chances are, in the long run, against him."

THE LATE COLLISION ON THE TROY & BOSTON RAILROAD.—L. W. Johnson, the seventeen-year-old operator against whom it is alleged that his negligence caused this accident, has been arrested at Hoosick Falls and taken to Troy. In the subsequent hearing of the case, Johnson pleaded not guilty to the charge of manslaughter in the second degree. He was subsequently released on bail.

A NEW TELEGRAPH COMPANY.—The National Telegraph Company was incorporated at Albany, N. Y. Aug., 20. The capital stock was fixed at $25,000, with the provisions that it may be increased to $10,000,000. The stockholders are Calvin S. Brice, of Lima, Ohio; Frank E. Worcester, of Brooklyn, and John W. Simpson, Herbert L. Terrill, Walter Katte, and James E. Childs of New, York.

TELEGRAPH CORPS REUNION.—The Society of the United States Military Telegraph Corps had fixed upon the 19th of September for its annual reunion to take place in Chicago The Old Timers have theirs on the 20th. Members of both organizations will join on the 19th in their social entertainment, ending with a banquet in the evening. The business meeting of the military society will take place at 10 A. M. on the 19th, and that of the Old Timers at the same hour on the 20th.

ALLEGED OUTRAGE.—It is charged against the Western Union that on Wednesday the linemen employed to set up the new instruments in the Mutual Union Building, Chicago, not being found competent to set up the quadruplex and duplex instruments, the officers of the company engaged four men from among the strikers, promising them permanent positions if they would perform the job. After the men had accomplished this, they were dismissed, at the end of only four hours' service.

THE PROPOSED COMPETITION BY THE GOVERNMENT.—Mr. A. H. Seymour, a telegraph operator and manager of 31 years' standing, believes that for $25,000,000 the government could duplicate the whole plant of the Western Union, and urges that such an enterprise should be organized upon sound civil service reform principles. Says the New York *Times*, "If that remedy could be resorted to the Western Union would have only its own greed and lack of fairness and decency to thank for the result."

OLD-TIME TELEGRAPHERS' ASSOCIATION.—W. S. Chapman, treasurer of this association, has issued the following, from his office, No. 110 La Salle street, Chicago: "At the annual meeting of the association at Niagara Falls last year, the annual dues of members was fixed at one dollar. This amount is, therefore, now due from each member, and you are earnestly requested to remit the same upon receipt of this notice. It is expected that we shall have a large attendance at the annual reunion here next month."

DEATH OF A TELEGRAPHER.—Mr. Richard Bean Garret, telegraph operator in the Western Union office, Havre de Grace, died at the residence of his stepfather, Mr. Alexander Hunter, No. 56 Thames street, on Saturday, after a brief illness, and was buried yesterday in the Methodist Cemetery, Philadelphia road. Rev. Harry Boggs, of Burke street M. E. Church officiated. The active and honorary pall-bearers—all telegraphers employed on the line with the deceased—were: C. M. Thomson, P. E. Brown, G. W. Plummer, C. C. Prince G. F. Clark, J. R. Baldwin, George Hunter, Joseph Warner, Jr. Malcolm Osmond and Samuel Lawder.—*Baltimore Sun, Aug.* 14.

ANOTHER CONSOLIDATION.—The control of the business of the Southern Telegraph Company has been secured by the Bankers' and Merchants' Company, which has bought sufficient of its stock for this purpose. No change was made in the official membership of the Southern Company in consequence of the consolidation. A. W. Dimock, formerly vice-president of the Bankers' and Merchants', has succeeded William M. Maris as its president. By consolidating with the Southern, the Bankers' and Merchants' secures control of lines extending from Washington to a point near Charleston, S. C. In a short time the wires will reach Charleston and Savannah, Ga. It is alleged that six new wires, with river cables, are to be strung between New York and Washington. Wires will probably be run to Chicago at once.

DISADVANTAGES OF TELEGRAPHIC BREVITY.—Mr. Gladstone, in his recent speech delivered at the Mansion House, London, said: "While we acknowledge the enormous benefit which the telegraph has conferred, we should be on our guard against the special risks of misapprehension with which that succinct method of communication is specially attended; for the knowledge of important, perhaps painful, at any rate of critical, events is conveyed in a fewness of words which would not be observed in the more ordinary methods of communication: Undoubtedly there is a risk lest inferences should be drawn which subsequent and fuller knowledge will show not to have been justified, and that risk can only be met by the generally prudent habit of mind which disposes us to receive with some reserve as to our final judgment whatever intelligence comes to us in that peculiar form." These sentences are commendable not only for their truth and wisdom, but as models of exact and elegant expression.

UNDERGROUND LINES IN CHICAGO.—It was announced at Chicago on the 10th inst. that the Postal Telegraph Company had been completely successful in its conduit scheme for carrying wires underground. One of the stockholders of the company informed a reporter as follows: "The conduit which we laid from Thirty-ninth street down Wentworth avenue to Thirtieth street, and thence to Lasalle and Washington streets, has proved a complete success. It is now in permanent use by the Postal Telegraph Company, which has leased room for two Paterson cables. This company has experienced no difficulty or inconvenience whatever. The Vandepole Electric Light Company has also placed wires in the conduit from Thirty-third street to Wentworth avenue, as a matter of test, and the result has been perfectly satisfactory. Telephone wires have been tried in it with like result. Why, Prof. Elisha Gray, the electrician, and other experts, have made tests to their complete satisfaction, and they all unite in saying that a combination of telegraph, telephone and electric wires in the conduit will not destroy its utility."

THE TELEGRAPH AS A POLITICAL ISSUE.—The debt question being out of the way, the Virginia coalitionists are now beating about for new issues with which to confuse the people. As already indicated in the *Sun*, Senator Riddleberger has fired a broadside against railroad corporations, despite the fact that the coalition leader, Gen. Mahone, has been a prominent railroad man, and has earned the unenviable soubriquet of "the boss railroad wrecker." But fearing the railroad issue may not win, the coalitionists have fallen back on the telegraph question, as is indicated by the proceedings of the Augusta County coalition convention a few days ago, at which resolutions were adopted requesting the members of Congress of that party to do all they can to secure the passage of a law by Congress establishing a government telegraph system. A peculiarity of the resolutions of Virginia coalitionist conventions is their remarkable similarity, indicating their inspiration from headquarters, and therefore it is not surprising that the announcement is made that the telegraph resolutions will be indorsed at coalitionist county meetings throughout the State. But with the state of feeling now existing in Virginia against the further continuance of boss rule in politics, it is hardly possible that the question of a goverment telegraph can be made a distracting issue. —*Baltimore Sun.*

THE POSTAL TELEGRAPH COMPANY.—The Postal Telegraph Company was incorporated June 21, 1881, by Henry Cummins, the present vice-president; ex-Secretary Fanshawe and Samuel C. Gallaher. The capital stock was fixed at $3,000,000, which might be increased to $7,000,000. The stock of the company is not listed in the Stock Exchange, but there is said to be between one and two millions of it on the market. Mr. Mackey, it is thought, may be instrumental in inducing Senator Fair, of Nevada, also to join the company. The combined wealth of these three men is enormous. Mr. Mackey himself could, it is thought, construct an entire telegraph system with his own resources. Mr. Mackey, it is stated, has pledged himself to support the company in stretching wires to and from every profitable point connected by the Western Union Company. His attention was first directed to the Postal Telegraph scheme last fall while he was on his way to Europe. On his return, recently, he investigated it thoroughly, and becoming satisfied that it was a good investment, entered the company. The impression is gaining strength that the immense wealth of the Postal Telegraph Company will lead to its becoming a successful competitor with the Western Union. Recent troubles between operators and the "monopolists" at No 195 have proved a good thing for the younger and hopeful organization.

UNDERGROUND TELEGRAPHY IN PHILADELPHIA.—The Brooks Underground Conduit Company, Philadelphia, have completed arrangements for a trial of their system for laying electric wires under ground. Their new system of laying wires, as far as a recent test shows, entirely obviates the difficulty hither experienced in laying telephone and telegraph wires in the same conduit, the click of the telegraph instrument drowning out messages over the telephone wire. By the Brooks plan a number of wires are taken which have been wound with cotton and boiled in paraffine. Thus all watery moisture is driven out and the wires are insulated. From the wires a cable is made. Around the cable another wire is wound, which prevents induction. The cable is then led through wrought-iron pipes sunk 18 inches under ground, and at openings in this pipe, two or three to a block, connection is made with houses and lamp-posts. When the arrangements are completed paraffine oil from an elevated reservoir is forced into the iron pipe, driving out air and surrounding the cable. In the test of the system the company have a cable of 33 telegraph and telephone wires, extending a distance of two miles and a half. Ten of the wires are in constant use by the Western Union Telegraph Company connecting their office at Tenth and Chestnut streets with New York. The telephone wires are laid side by side in the same cable with the telegraph wires. Besides the fact that underground wires are by far less liable to interruption, it is claimed that by that system a cable of 100 wires can be laid at a cost of $40 a mile per wire, while ordinary overhead telegraph wires cost $100 per mile, and telephone wires $50.

DR. GREEN EXPLAINS.—Dr. Green, who returned from England on Sunday, gave the reason why Western Union stock was not listed in London, as follows: "No attempt whatever was made to list the Western Union stock in London, because such an attempt would have been abortive. The rules of the London Stock Exchange require, before a stock can be listed, that a considerable amount of the stock shall be held in London by London investors in their own names, and that a list of bona fide owners shall be filed with the exchange when the stock is listed. Business on the exchange there is done in an entirely different manner from that pursued here. There is no dealing on margins, and comparatively no speculation. The English are too conservative for that. They are not speculators. They are investors. Sales made on the exchange are bona fide transactions for cash. The stocks listed are actual investment stocks, and a listing is a guarantee of the solidity of a security. In order to list Western Union it would have first been necessary to place a large block of stock in the hands of English investors. I found a number of stockholders there, but they were speculative holders only, and their stock was held in New York in the name of their brokers. This was, of course, of no use in any scheme that might have been entertained of listing the stock. The necessary amount of stock could have been placed. Mr. Gould could have disposed of a block of 50,000 shares had he wished to do so. Arrangements were entered into, and at one time it looked as though they would be successful. But there was a failure to agree as to the price, and so the negotations for the sale of the block fell through. This failure was due in great measure to the mistrust of American securities as a whole, and by the fluctations which occurred while the negotiations were in progress." We hear that the Executive Committee of the Western Union has expressed itself as not pleased with the remarkable frankness of President Green, as indicated in this quoted utterance. They believe, however, that had he known at the time he made it the condition of Western Union stock in Wall street, he would not have spoken of the company's business with so great freedom.

RECENT TELEGRAPH DECISION.—An action was brought to recover damages against a telegraph company for negligence in transmitting a dispatch so that it was not promptly delivered. The mistake was in the transmission of the name, "Heiran" being not "Hermen." On the telegraph blank used by the sender it was stated as the contract between the parties "that no claim for damages shall be valid unless presented in writing within twenty days from sending the message" No claim for damages was made until twenty-four days after the sending of the message. The trial court decided in favor of the company, and the plaintiff carried the case, Heiman vs. Western Union Telegraph Company, to the Supreme Court of Wisconsin, when the judgment was affirmed. Judge Orton, in the opinion, said: This condition as to making a demand for damages in a stipulated time is valid. Such a condition has been held obligatory in insurance, freight and other contracts, and legislation where damages have resulted from accident or negligence, and in such cases the principle is indisputable. But it is charged not unreasonable that a telegraph company should require notice of claim for its default within a reasonable time, before being held to answer for the alleged default. From the nature of its business this may be essential to its protection against unfounded claims. Another reason is found in the multitude of messages transmitted, requiring a speedy knowledge of claims, to enable the company to keep an account of its transactions before, by reason of this great number, they cease to be within recollection or control. It may be added that this was a night message, at one-half rates, because of its not requiring repetition; and on account of its liability to mistake, error or delay, and of the common uncertainty and greater labor of night work, the company should not be held unless there is the clearest liability.

THE TELEPHONE.

WELLINGTON, O.—This enterprising village was connected by telephone with the Cleveland exchange last week, and is now putting on city airs.

ERIE TELEPHONE COMPANY.—The increase of subscribers for July 1, without the Southwestern, was 450. Placing the Southwestern at 200, the total is 650.

EXTENSION IN MICHIGAN.—The telephone line from East Saginaw to Detroit, 100 miles in length, has been completed and opened by the Michigan Bell Telephone Company.

RE-ELECTED.—Mr. W. T. Westbrook, superintendent of the system of Wilmington, Del., has been unanimously re-elected superintendent of the city fire alarm telegraphs by City Council of that place.

THE TOMBS TELEPHONE STRUCK BY LIGHTNING.—On Tuesday lightning struck the telephone instrument at the Tombs prison, this city. The box being immediately examined, it was found that the wires were melted, the alarm gongs cracked and the woodwork burned.

THE DOLBEAR TELEPHONE AND MAGNET.—The Dolbear Telephone Company, it is stated, had no interest in the late omnibus decision touching telephone matter, in which the claim of Prof. A. E. Dolbear as inventor of a telephone receiver was disallowed. It was the Dolbear magnet that this claim related to. The magnet was sold by the Professor to the Gold & Stock Telegraph Company, and turned over to the American Bell in the deal between the Western Union and Bell Company. The Gold & Stock or some other interest put in an interference, and hence the suit.

PROGRESS OF THE CENTRAL UNION TELEPHONE COMPANY.—The line of this company from Circleville, O., to

Washington C. H. was completed on the 17th inst. It has 30 poles to the mile, is of #9 wire, with a #12 wire to Williamsport and New Holland. Its completion connects Circleville with Washington C. H., Wilmington, Sabina, Hillsboro and Bloomingsburg. A line is being built from Washington to Springfield. Circleville now has lines to Chillicothe, Kingston, Adelphia, Tarlton and Darbyville. The exchange at Circleville will be entirely reconstructed during the coming fall.

THE FALL IN BELL STOCK.—A writer on the staff of the Boston *Herald* has been interviewing persons interested in telephone stocks as to the recent fluctuations in Bell stock. He found among them a gentleman who asserted "that there were two or three holders of Bell stock who were well satisfied that the stock would be a good investment, at least until the Drawbaugh cases are finished. Firmly cherishing this belief, they got together and organized themselves for the purpose of precipitating a scare, and by thus frightening outside holders and encouraging them to unload on the market simultaneously, they reasoned that they would be able to increase their own holdings at a comparatively low figure. The time selected was a most favorable one, as all will agree; and, although such schemes are neither new nor novel, yet it is held that it was far more successful than the projectors anticipated."

THE SOUTHERN NEW ENGLAND.—At the meeting of the New England Telephone Company on Aug 16, to vote on the consolidation with the other New England companies, Mr. Tayler of the Southern said that one great advantage of consolidation, in addition to that derived from the union and common operation of the different companies, would be to make their new stock certain of earning a dividend. It was preferred stock, while that issued to the American Bell Company was common stock. Including the $50,000 surplus in the treasury, the stock dividend to the Southern New England stockholders was about $189,50. They owned two metallic circuits between New York and Boston, which would doubtless become very valuable when further improvements were made in long-distance telephoning. These the company would still retain. It would also mantain a corporate existing despite the consolidation. All the new England companies, with the possible exception of the Providence, were sure to come into the consolidation scheme. That company's plant cost $200,000 and they had been offered $800.000 of the new stock.

TELEPHONE STOCKS.—The Boston *Economist* of this week, speaking of the activity in telephone stocks during the week, says that in Boston over 5,000 shares of Bell have been sold. The price has been put up from 210 to 259½. The recent decline was due to the condition of lawsuits and opposition, but the advance is directly traceable to manipulation. The Bell Company's share in the capitalization of the New England Telephone Company is $8,000,000 of stock. Of the whole United States, this represents, in the present ratio of telephones, about one-fifth, so that the Bell Company's interest altogether in the local exchange may be considered roughly at $40,000,000. On this investment it will probably receive in dividends this fiscal year $350,000, and in succeeding years $350,000, average annual increase, until by the eighth year it is receiving over 6 per cent. upon the whole $40,000,000. Besides these dividends, its net rentals this year are likely to be over $1,308,000, against something over $1,000,000 last year, a gain of 30 per cent. An annual average increase net from February last of 15 per cent. would in five years give net rentals of over $2,000,000, in eight years over $3,000,000, and in ten years over $4,000,000. The past two years have already shown an annual increase of more than 20 per cent. in telephones in use. Within five years the Bell Company's gross income ought to be $4,000,000, and its net at least $3,000,000. This all presupposes that the Bell Company will continue to hold a monopoly of the business. Mr. Reiss and the Supreme Court of the United States are yet to be heard from before this fact is settled. Those who are about investing in this stock would do well to find out all about the facts that will be brought up before that august body. Mexican Telephone is doing nicely and shows an advance. Six weeks ago everything regarding the company was in doubt, and a debt of some $32,000 existed. To-day $25,000 of that debt has been canceled, leaving a balance not yet matured, but which will be met at maturity. The manager has shipped eighty sets of instruments to the parent company, fifty sets to the Mexican Peninsula, and forty sets to the Chihuahua subordinate companies. A dispatch from Supt. Wiley says the company's business is excellent. Five hundred and fifteen telephones have been connected in the City of Mexico, in addition to five private lines. The Guadalajara Company earned in June $791.14, all of which was put into expenses and plant, and no call made on the treasury of the parent company. The 25,000 shares of new stock have been issued and paid for, and the company now has a good working balance in the treasury. The general manager says they will promote the business as fast as possible. Had this property been well managed in the past, the company ought to have been earning a dividend to-day. People's Telephone is in demand at 9¼@9½; Bay State 100@120; Boston and Northern 120@130; Currier 20; Erie 61@62½; Granite State 85; National Bell (Maine) 70@80; New York and New Jersey 95@100; New York and Pennsylvania 90@91; Suburban 107½@115; Tropical 2@2½; Union Telegraph and Telephone 100. The special "test wire stock" of the Spiral Telephone Wire Company has been taken, and wires are now being strung to Lowell and Worcester. The company clears two and one-fourth cents per pound net, and has been on an earning basis since its date of organization, March 27, 1883.

THE ELECTRIC LIGHT.

JAY GOULD'S ATALANTA is provided with 150 Edison lights, furnished from one dynamo.

HOME AGAIN.—Mr. A. H. Reece, agent for the Brush Electric Company, has returned to Cleveland after a two years' residence in Brazil.

A PAINFUL ACCIDENT.—Mr. B. A. Guering, superintendent of the Electric Supply Company, of Cleveland, had the index finger of his right hand accidentally crushed last week, and had to have it amputated.

ELECTRIC LIGHT IN LOWELL.—The Middlesex Electric Light Company expects to have fifty lights in operation before the 1st of September. The Lowell *Citizen* reports that the officers of the company are confident a dividend equivalent to 8 per cent. will be declared in October, notwithstanding the heavy outlay caused by the recent purchase of the Lowell company's property.

RIVALRY IN DES MOINES, IOWA.—Since this city began putting on metropolitan airs there has been inaugurated a spirited rivalry, which is not confined to mercantile pursuits, but has reached out until it now embraces the electric light system, places of amusement, street railways, etc. A second electric light company has recently been formed, which is now furnishing a soft, steady, mellow light at $10 a month per lamp, and the result is that a large force of men is kept very busy supplying the demand.

LIGHTS IN INVENTOR SWAN'S HOUSE.—Lauriston House, Bromley, England, the residence of Mr. Swan, the inventor, is lighted throughout with electricity in a most complete manner. Every room and closet within the house, to the very coal-cellar, can be lighted at will. If a person wishes to enter a bedroom, for instance, the movement of a switch illuminates it before he opens the door, and then when he comes out he can as easily make the room dark again. The fittings are described as elegant.

CONDUCTING POWER BY SELENIUM.—We have received the following communication from Lieutenant Bradley A. Fiske, U. S. N.: "Referring to the electric candle regulator of M. Tomassi, described in your issue of Aug. 11, 1883, I would respectfully suggest that the experiments of Willoughby Smith, Siemens and others (including myself), show that the conducting power of selenium, on exposure to light, decreases very rapidly, so that it would be impracticable to use it for the purpose indicated."

EDISON AMONG THE BALLET GIRLS.—This from a reporter of the New York *World*, present at a ballet rehearsal in New York: "Then the spare and quite ordinary man who is moving among the girls and adjusting their corsets is one of the dressers?" "No; that is Mr. Thomas A. Edison, the electrician and inventor." "Is he a dancing-master—has he invented a new step?" "Not exactly. He has armed each one of those girls with a little battery, and at a signal each one will flash out on the stage with an electric light on her forehead. It will be dazzling."

ELECTRIC LIGHTS ON STEAMERS.—The Chicago *Tribune* says it seems singular that the electric light has not been more extensively introduced on the passenger and freight steamers navigating the inland lakes. Such lights have proved highly successful on the river packets and Sound steamers, but so far only two boats entering Chicago have adopted them. On the excursion steamer Gazelle there are four electric lamps, which illuminate the boat brilliantly, and can be seen for miles. The apparatus is comparatively inexpensive and the cost of running a nominal consideration, when the advantage gained is taken into account.

ANCIENT AND MODERN ILLUMINATION.—The city of Mexico is described by a recent traveler as a city of contrasts. These contrasts are marked at every turn. In the upper stories of houses are families enjoying every luxury of food, clothing and surroundings, while on the ground floor huddles the family of the portero in their bare rooms, content with scant wages, slight clothing and the coarse food of their Indian ancestors. The main thoroughfares are lit by the electric light, the neighboring streets by gas, and further away the rest of the city is lit by the dim oil lights hanging on ropes over the middle of the streets, like those in primitive European towns.

FIRE IN THE EDISON ELECTRIC ILLUMINATING COMPANY'S BUILDING.—A fire broke out on Monday night in the rear of the top floor of the four-story building No. 255 Pearl street, which, with No. 257 Pearl street, is owned and occupied by the Edison Electric Illuminating Company, and is known as their central station. One minute after the first alarm was sent out a third alarm was struck, so that 11 engines and four hook and ladder companies were on the ground, but it was evident that the fire was well under control, and several engines did not extend their hose. At 11:30 o'clock the fire was out and the damage does not exceed $3,000. The fire was no doubt caused by spontaneous combustion of oily rags.

ELECTRIC LIGHT WANTED AT MEADVILLE, PA.—At a meeting of the Meadville (Pa.) Council, on Aug. 15, Mr. Brock, of the Maxim Electric Light and Power Company, handed in his bid for furnishing 50 arc lights. Mr. Avery, representing the Brush Electric Light Company, of Cleveland, stated that he was not prepared to make a bid to furnish the city with electric light, because he had not yet learned exactly what the Council desired, but he stated confidently that he would light the city more cheaply and better than 35 lamps would do it, placed on short posts by means of three masts or towers 150 feet high. On these masts there would be placed four 2,000 candle power lamps. Mr. Avery seemed to hold to the opinion that it is only by a combination of the mast light and the low light systems that the best results can be achieved in cities like Meadville. He cited as examples of successful and cheap electric lighting by the mast system, Evansville, Ind., Aurora, Ill., and other towns. Mr. Brock and Mr. Avery advanced the claims of their lights earnestly, and it was finally decided that the special committee be granted more time in which to receive, open and consider propositions from electric light companies besides the Maxim. The most important item of information developed by the discussion was that it would cost $3,650 per year to run 40 arc lights, or $10 per day.

MISCELLANEOUS NOTES.

COMMISSIONER MARBLE, of the Patent Office, will resign his office on the 1st prox. He has held the position about two years.

THE GRAMME ELECTRICAL COMPANY'S PATENTS.—The last published "list of patents" owned and controlled by the above company bears date Aug. 1, 1883, and contains the name of patentee, date and number of 499 patents. A new feature of the "list" is the publication of the officers and directors of the seven companies comprising the Gramme Company.

THE ELECTRIC RAILWAY AT LOUISVILLE.—The electric railway at the Louisville Exposition, same as described in the Aug. 4 issue of THE ELECTRICAL WORLD, made its trial trip on Aug. 10. The first passengers carried by it were the directors of the exposition and members of the press. The track is a circular one, three thousand feet in extent. The circuit is made by the train in three minutes.

UNION ELECTRIC MANUFACTURING COMPANY.—The employés of this company made a pleasant excursion on the 24th inst., the Fishing Banks, their objective point. The Union Electric Company is, we are glad to learn, now doing an excellent business. The officers of the company are as follows: President, W. T. Mersereau; vice-president, F. M. Jones; treasurer, H. C. Andrews. The factory is at Nos. 7 and 9 Bond street, and the office at No. 145 Broadway, this city.

REPORTED NEW CABLE SCHEME.—A report was circulated in Wall street on Tuesday that certain prominent capitalists had pledged themselves to lay two new cables across the Atlantic, subscribing 4 millions out of a capital of 5 millions appropriated for this purpose. The names mentioned were John W. Mackey, the California millionaire; John W. Garrett, the president of the Baltimore & Ohio Railroad; his son, Robert Garrett, and James Gordon Bennett. If true, this would look like a revival of the B. & O. cable scheme. Mr. Mackey, however, on being questioned on the subject, expressed his surprise at the report.

FREAKS OF THE LIGHTNING AT ELMIRA.—The Elmira *Tidings* reports that the Hon. S. B. Elliott, of Tioga, Pa., was a visitor at a house in Elmira a few days ago, when a thunder storm arose. After the first loud thunder clap was heard he left his bed and went out of the room to see if the windows in an adjoining room were closed. While out of the room the second report came. Returning to his room Mr. Elliott stubbed his toe against some slivers lying on the floor. He procured a light, when it was found that the bed which he had been occupying was broken in splinters and scattered around the room. The electricity had passed through the woven wire springs and shattered the side rails of the same. The whole family were badly frightened.

ELECTRICAL CONDUIT CONSTRUCTION COMPANY.—This company, of which the articles of incorporation were filed at Albany, on Wednesday last, has a capital stock of $1,000,000, divided into 100,000 shares. The incorporators are: H. W. Pope, vice-president of the Manhattan District Telegraph Company, of New York; A. B. Chandler, of the Fuller Electrical Company, of New York; H. W. Fairbanks, superintendent of the Postal Telegraph Company; C. A. Brown, manager of the Western Electric Company; S. F. Kneeland, of New York; Prof. Elisha Gray and D. N. Hurlbut, of Chicago. The company was formed for the purpose of extending the underground cable system now used in Chicago by the Postal Telegraph Company. This system is the invention of D. N. Hurlbut, a telegrapher of Chicago, and one of the incorporators of the company. It provides for the economical placing of telegraph and telephone wires underground, has been tested and found efficient and remarkably cheap, and is recommended by eminent practical telegraphers.

STOCK QUOTATIONS.—Telegraph, telephone and electric light stocks were quoted on Thursday of last week and Thursday of this week as follows:

	Aug. 16.	Aug. 23.
American Cable	65	....
Bay State Telephone	....	120
Bell Telephone	229	239
Currier Telephone Bell Co	....	20
Granite State Telephone	85	85
Mexican Telephone Co.	2¼	2⅝
National Bell Telephone of Maine	79	80
Suburban Telephone Co	125	125
Tropical Telephone	2	2⅛
Western Union Telegraph	73⅜	77⅛
Bankers and Merchants' Tel	139	....
New York and Pennsylvania	90	92½
Boston & Northern Telephone	115	130
Union Telegraph and Telephone	....	100
Erie Telephone	58	60½
United States Electric Light	....	115
Edison Electric Light	225	280
People's Telephone	....	111
New York and New Jersey	100	98

RUNNING WIRES INTO THE ST. LOUIS CUSTOM-HOUSE.—The new Custom-House at St. Louis is rapidly approaching completion. A part of the Signal Service Department has already moved into the building, and last week Mr. Baker, telegraphic manager of the service, had a conference with Superintendent Cameron as to the best manner of introducing wires into the building. Mr. Cameron was decidedly opposed to any wires being run into the building from above the surface, on the ground that they were unsightly, inconvenient and likely to become dangerous. He advocated running them down the bridge ventilating shaft at the corner of St. Charles and Eighth streets, and thence to the building through the tunnel. This, however, was opposed by Mr. Baker, because the wires were likely to rust in the tunnel. Mr. Cameron then proposed that they be run to the post just opposite the Locust street entrance, and thence to the ground, and into the building under the Belgian pavement at the main entrance. This was agreed to by Mr. Baker, and the work will begin in a few days. After getting into the building, the wires will be carried through some of the shafts inside to all floors and offices desired, the chief office being at the corner of Eighth and Olive streets.

FIRE AT THE WESTERN UNION OFFICE, CHICAGO.—Soon after six o'clock on Tuesday morning a fire broke out in the five-story building at Chicago, occupied in part by the Western Union Telegraph Company. It originated in the operating department in the fifth story of the building, and within twenty minutes every description of property on the floor was a mass of ruins. Ten men were on duty at the time besides the night manager. The fire originated by two duplex battery wires near the switch-board coming in contact with a gas-jet, and everything was in a blaze in a moment. Within five minutes from the discovery of the blaze the skylight and transoms fell in. The fire department was on the scene quickly, and beyond a heavy drenching given to every portion of the building, no special damage occurred to the main structure below the fifth story. The Western Union officers immediately began the removal of their property to the building on the north side of Washington street, where the equipments of the Mutual Union Company enabled them to continue to handle a portion of the business, and preparations were at once made to remove the entire business into that structure for the time being. The market and stock quotations ceased for a time and little business was contracted on 'Change. The loss to the Western Union Telegraph Company will not exceed $20,000, on which there is an insurance. The loss on the building is $30,000, and the insurance, $130,000. The sign "Messages taken subject to delays" appeared at the Western Union office on the floor of the New York Stock Exchange in consequence of the fire, and the brokers thought that the strike was in progress until informed of the true reason why the recently familiar announcement had reappeared. Business between New York and Chicago was at a standstill for some time.

DEPARTMENT OF INQUIRIES.

38. THE CURRENTS IN INDUCTION COILS.

I desire some information as to the strength of an induced current as compared with the primary current giving it birth. Is the induced current possessed of greater electromotive force than the primary inducing it? If so, why? Why is it that a shock from the second circuit is painful, while the current from the primary is hardly appreciable? From inquiry it is evident that there is much ignorance on the subject of induced currents among telegraph men who are pretty well up in their business, and some detailed information on the subject would be a boon to many of your readers. INQUIRER.

APEX, N. C.

Whenever a closed circuit is moved in the space surrounding a magnet, and which is called a "magnetic field," or whenever the magnet and its magnetic field are themselves displaced relatively to the circuit, a current of electricity is induced in the closed circuit, which lasts as long as the relative displacement continues. Thus, if two distinct circuits run parallel for a part of their course, any change in the magnetic field produced by the current in one will cause a reciprocal change in the electrical condition of the other circuit. On introducing the current in the first circuit, a momentary impulse of current will flow in the second circuit. As long as the magnetic field of the first current remains constant, no further effect is produced in the second circuit, but if the current be increased the impulse continues. On decreasing the current or on interrupting it, the impulse is then produced in the same direction as in the primary circuit. Moving the second circuit nearer to the first while the current is constant in the first would also give rise to an impulse similar in direction to that in the first case, and moving it away, would give rise to a contrary impulse. The strength (electromotive force) of the impulse depends on the power of the magnetic field and on the rapidity with which the variations are made to take place. It depends also *on the length of wire subjected* to inductive action. An induction coil is composed of an inner or "primary" helix, through which the inducing current passes in rapid impulses, and an outer or secondary helix, in which the induced currents arise in consequence of the rapid variations of the magnetic field produced by the inner helix. A core of iron is placed in the inner coil, in order that the iron may concentrate the magnetic field, and thus render it more energetic in its effects on the secondary helix. In the induction coils used for medical purposes the secondary helix is made of fine wire of many turns, in order to produce a high electromotive force. For other purposes, however, the secondary helix is sometimes made of a few turns of larger wire, and then the electromotive force of the induced current is low.

The shock produced by the electric currents from induction coils depends on the rapid intermittance or alternation of the impulses of current. The current primarily excites the nerves and the muscles, and causes strains in the various parts of the human frame which are immediately succeeded by reactions, but these reactions are constantly checked by the recurrence of the impulses. Since the impulses are alike in number in the primary and the secondary circuits it would seem as if the effects ought to be similar, but the difference of electromotive force accounts for the discrepancy. The resistance of the human body is so high that it requires a high electromotive force to produce the passage through it of the current in perceptible quantity. The electromotive force of the battery in the primary circuit is usually under two volts, while that of the secondary circuit may be several hundred volts. If we were to increase the number of cells in the primary circuit to fifty or a hundred, so as to obtain a higher electromotive force, the shock obtained from the primary circuit would be as powerful as that from the secondary of the usual kind. Further details on induction coils will be found in reply to inquiry No. 34 in the issue of June 16.

39. THE "DRAWER" BATTERY.

Please let me know through THE ELECTRICAL WORLD what kind of fluid you mix with the red lead for coating the lead of the "new battery" mentioned in THE ELECTRICAL WORLD of June 9. I made a battery coating the lead plate by mixing the red lead with raw linseed oil, but could not get it to work at all. Please state also whether the zinc is negative or positive.

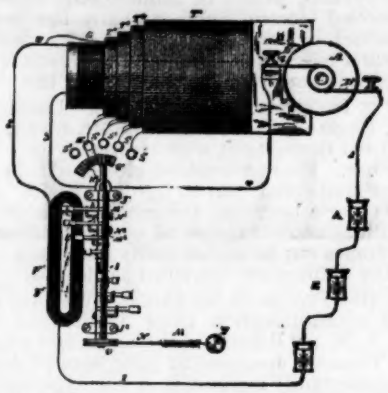
LORAIN, OHIO. "FRANK LYNN."

The red lead may be mixed with pure water without difficulty and applied as a paste. The addition of a small quantity of sulphuric acid is considered an advantage. The reason why the battery failed to work was that the oils are good non-conductors, and in this case the lead plate was practically insulated, and besides, the solution was repelled by the oil, so that no action could take place. The zinc constitutes the positive *plate*, because the current passes from the zinc to the lead plate in the liquid. Outside of the liquid, however, the current proceeds from the wire attached to the lead to that connected with the zinc, and for this reason, the zinc binding screw is generally called the negative *pole*.

ELECTRICAL PATENTS ISSUED

And Dated August 14, 1883.

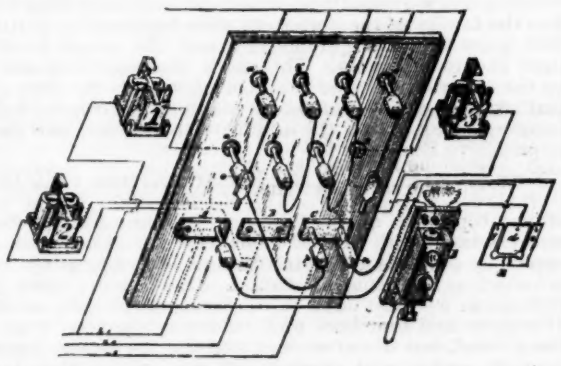
Apparatus for making glass insulators; Mathew Johnson, Ellenville, N. Y.....282,989
Composition for coating and insulating underground wires; Henry R. Brissett, Lowell, Mass.....283,200
Composition to insulate, preserve and protect wire for electrical purposes; Doulee B. Turner, Chicago, Ill.....283,044
Electrical indicator for speaking tubes; Jacob Capron, New York, N. Y.....283,073
Electric arc lamp; William M. Thomas, Cincinnati, O...283,042
Electric battery; Chas. P. Orne, Cambridge, Mass.....283,355
Electric circuit track instrument; Charles A. Scott, Boston, Mass.....283,152
Electric commutator or switch; Elihu Thomson, New Britain, Conn.....283,167
Electric lamp; Forée Bain, Union City, Ind.....283,186
Electric locking mechanism for switch and signal levers; Oscar Gassett, Boston, Mass.....283,231
Incandescing electric lamp; Samuel D. Mott, Menlo Park, N. J.....283,270
Removing tin from tin scrap by electricity; James L. Delaphaine, Joseph G. Hendrickson and Francis J. Clamer, Philadelphia, Pa.....282,964
Rheostat; George W. O'Harra, Kalamazoo, Mich.....283,138
Secondary battery; Eli T. Starr, Philadelphia, Pa.....283,295
Speaking telephone; Francis Blake, J., Weston, Mass...283,062
Spring jack and circuit for through telephone lines; Charles H. Wilson, Chicago, Ill.....283,312
Telephone; Charles Egan, Zanesville, O.....282,969
Telephone local call instrument; William Nichols, Boston, Mass.....283,354
Telephone transmitter; William C. Lockwood, Brooklyn, N. Y.....283,123
Regulator for dynamo-electric machines; Robert J. Sheehy, New York, N. Y.....283,155



The invention consists in a method of regulating dynamo-electric machines so as to maintain a uniform current in the working circuit.

The external or working circuit includes an electro-magnet F^1 whose attractive force increases or diminishes with the current in circuit. The armature blades L_1, L_2, etc., attached to the shaft I in bearings J_1 J_2 respond to this varying attraction, and cause the rotation of the shaft which recovers itself by means of spring M, when the attraction diminishes. The shaft carries a bevel wheel at one end which serves to move a switch H_1 H_2, which by the motion of the shaft is made to touch the contact points S_1 S_2 S_3 S_4 S_5. The field magnet is wound with coarse wire G as usual, and also with fine wire coils T_1 T_2 T_3 T_4 all connected in series A^1 the point of connection they are connected to one of the contact button S_1 S_2, etc. When the current is normal the switch H_1 H_2 touches contact button S_3, and the current passes only through the large field wire G, but when it increases the electro-magnet F_1 causes the shaft to rotate and the switch to move until it touches the next contact button, as shown in the figure, in which case the current, instead of passing through the large field wire G altogether, divides at U, a part passing through G and a part through fine wire T_4, the amount in each branch being inversely proportioned to its resistance. The wire T_4 is connected so that its magnetism acts in opposition to that generated by the wire G, and consequently the field magnet loses in magnetic power, the current generated becomes reduced until the magnet F_1 is weakened enough to permit the spring M to move the switch back to S_3. If the current is very strong the switch becomes turned to contact button S_1, and in this case all the fine wire coils T_1 T_2 T_3 T_4 are included in the circuit and the field magnet weakened still further.

Central office apparatus for telephones; Leroy B. Firman, Chicago, Ill.....283,334

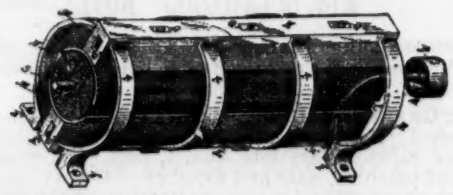


A, *B* and *C* represent connecting plates on the switch board at the central office. *D* is the operator's telephone outfit. *E* is a peg switch. L^1, L^2 and L^3 represent the respective lines of three subscribers, designated as S^1, S^2 and S^3. The telephone line of each subscriber, when not in use, passes through an annunciator number and two bolts and to ground at the central office. Thus S^2 is connected by his line L^2 with annunciator number 2 and thence to bolt *b*, and by the plugs and flexible conducting cord to bolt *b'*, and thence to ground, as shown. The subscribers signal the central office when they wish to be connected through the central office, by sending currents along their telephone lines. Thus if S^2 should send a current along line L^2 the shutter of his annunciator 2 would be released, and by this signal the switchman would know that S^2 wished to talk with some one. When the switchman sees a shutter fall he takes off the ground by pulling out a plug from one of the two bolts in the circuit of the subscriber who has sent in the call. The switchman then connects the connecting plate of the line of the subscriber with the operator's telephone through the peg switch. In the drawing the plugs that belong in bolts *a* and *c* are thus removed or pulled out and are allowed to hang, as shown.

Claim 1. The combination of telephone lines L and L^3 with connecting plates *A C*, each provided with two plug-bales, the branch circuits, including annunciators 1 and 3, and switching apparatus, as described, whereby either of said annunciators may be included in the circuit of said telephone lines when connected, as and for the purpose specified.

2. The combination of the telephone lines with switches, one for each line upon the central office switch board, branch circuits, one branch circuit for each line, each branch including an annunciator and switching apparatus, whereby any two telephone lines may be connected together through the annunciator of one of the lines, while the annunciator of the other line is not included in the circuit.

Electric lamp; Elihu Thomson, New Britain, Conn.....283,168



The object of this invention is to secure simplicity of structure, ease of manufacture and a better utilization and concentration of the magnetism upon the revolving armature, and to so construct the armature as to prevent the circulation of induced currents in the material thereof.

Claim 1. A field-magnet and frame composed of the two diametrically-opposite inwardly projecting cores *K K'* for the field-magnet coils, having curved pole-pieces, and the plain continuously-curved connecting-ribs *R*, suitably connected at their ends with said cores and free from internal projections, said ribs being curved from their point of connection, so as to bring their sides out of proximity with the field-magnets, as and for the purpose described.

2. The combination, with the cores *K K'*, diametrically opposite one another, of a series of curved ribs whose ends are attached to the outer ends of the cores *K K'*.

3. A machine and magnet-frame composed of the curved ribs, connected at their ends to the ends of the internally-projecting cores upon which the field-magnet coils are wound, and provided with the feet *F*.

4. A cylindrical or ovoidal field dynamo-machine frame, with internally-projecting magnet-cores extending toward one another, in combination with separately-attachable pole-pieces for said inwardly-projecting cores, as and for the purpose described.

5. The combination, with the magnet-cores *K K'*, of curved ribs *R*, provided with flanges *W*, substantially as described.

6. The combination, with the magnet-core *K*, recessed at *a a*, of the curved rib *R* and head of flange *W*, resting in said recess.

7. The combination, with the cores *K* or *K'* for the field-magnet of a dynamo-machine having a groove on its end, of the removable pole-piece *N* or *S*, having a tongue which enters said groove.

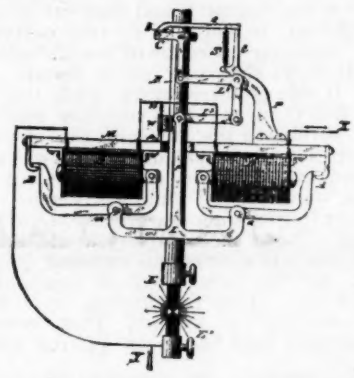
8. The combination with the core *K* or *K'* for the field-magnet of a dynamo-machine having a groove in its end shaped as described, of a pole-piece having a T-shaped tongue and set-screws *m m*.

9. The combination, with the armature-shaft, of the notched projections and the circumferentially-wound wire.

10. An armature or carrier for a dynamo-electric machine, constructed with radially-extending projections wound circumferentially, as described, and provided with the end plates or flanges.

11. The combination, with the radially-extending serrated projection forming the base of the armature-carrier, of the transverse and radial openings in the teeth.

Dynamo-electric machine; Edwin J. Houston, Philadelphia, Pa.....283,343



The main and derived circuit magnets act solely and separately in their respective ways, and the adjustment is such that no movement is imparted to the derived-circuit-magnet core or armature until after the main-circuit core or armature has come to rest and the arc has begun to lengthen by consumption, and the construction of the derived-circuit magnet is such that its core or armature has an extended range of motion and may rise any distance under the effects of the same current in its coils until said arc is less in length and the current in the derived coils diminishes.

Claim 1. The combination, in an electric lamp, with the lifting or actuating support for the clamp, clutch, or equivalent feed-controlling device, which, by its reciprocating movement, both lifts and causes the release of the carbon, of a main-circuit electro-magnet and a derived-circuit electro-magnet, both connected independently with said support, so that each may act thereupon reversely and independently of the other to move the same in opposite directions, said main-current magnet being adjusted to hold its armature or equivalent part in lifted position during normal operation of the lamp, while the derived-circuit magnet is adjusted to act only on an increase of the arc beyond normal length, and has with the same strength a constant or uniform pull on the feed mechanism in all positions of its armature.

2. The combination, in an electric lamp, of a lifting and feeding clutch or clamp, a lifting main-current electro-magnet, whose core or armature retains its attracted position during feeding operation, a core or armature controlled by a derived-circuit coil and responding only on an increase in the length of arc beyond the normal point, said core or armature having a uniform pull in its changed positions, and independent actuating and supporting connections between the main and derived-circuit armatures and the common clamp or clutch, so that they may act independently of one another, in the manner described, the one to lift and the other to lower the clamp.

3. The combination, with a common carbon separating and adjusting mechanism for an electric lamp, of a main-circuit electro-magnet for separating the carbons connected with said common mechanism, so as to actuate or support the same, and adjusted to retain its position during normal operation, and a derived circuit magnet acting reversely upon the same portion of said adjusting and feeding mechanism, to cause a feed independently of the main-circuit magnet, said derived-circuit magnet being adjusted to operate said mechanism only on an increase in the length of arc beyond the normal, and being provided with an armature whose pole, moving before the magnet, is curved or tapered, as and for the purpose set forth.

4. The combination, with a lifting and feed clutch, of a pivoted table or lever, *L*, having the two fulcrums or points of support *m n*, a main-circuit electro-magnet connected at one of said points, and a derived-circuit electro-magnet connected to the other point, and exerting a pull uniform in the various positions of its armature, as and for the purpose set forth.

5. The combination of the clutch, the lever L^2, the table or lever *L* fulcrumed or supported at opposite points *m n*, and main and derived circuit magnets, lifting the opposite ends of the lever dissimultaneously, as and for the purpose set forth.

6. The combination of the clutch, the lever L^2, table or lever *L* having two fulcrum-supports at *m n*, main-circuit magnet whose armature is connected to one side of said table and retains its lifted position during normal operation of the lamp, and derived-circuit magnet adjusted to lift its armature when the arc increases beyond a normal length, said armature and the pole that acts upon it being formed in any suitable manner, so that the pull will be constant in the various positions of the armature with reference to the pole.

BUSINESS NOTICES.

Mr. Charles L. Bly, who not long since succeeded to the business of Messrs. Stearns & George, is rapidly building up a large and remunerative business in Boston. His is already one of the largest general electrical supply house in New England, and he carries a full stock of annunciators, electric bells and general telegraph, telephone and electrical supplies. His advertisement will be found in another column.

Among the new advertisements in this issue is one of Mr. Curt W. Meyer. Mr. Meyer furnishes all kinds of apparatus and supplies necessary for the many interesting and beautiful experiments which can be made to practically demonstrate the various theories put forward regarding electricity. The apparatus is really inexpensive, and there is no better manner of studying the subject and impressing it on the mind than by the aid of these simple experiments. Mr. Meyer has issued a neat pamphlet in which the matter is explained and prices of the necessary instruments and supplies given.

THE

ELECTRICAL WORLD

INDEX TO VOLUME I.

JANUARY TO AUGUST, 1883, INCLUSIVE.

*ARTICLES MARKED * ARE ILLUSTRATED.*

EDITORIALS.

Accumulators, Manufacturing... 535
Another step forward 4
A second Bunker Hill 518
Ball's "Unipolar" Dynamo 358
Battery, A new kind of storage 535
Battery, A new constant 359
Battery, Scrivanoff's new 390
Boston telephone decision 68
Brotherhood's battle, The 470
Colossal scheme for a mid-ocean telegraph station 454
Conditions of electrical resistance of the human body. 438
Consolidation, The Genesis and value of 534
Death of W. E. Sawyer 309
Dishonest journalism. 502
Electric governor for the engines of ocean vessels, R. G. Brown's 390
Electric lighting, Edison on 84
Electric light on the Brooklyn Bridge 326
Electric railway in this country 374
Electric railways 276
Electrical amicability 454
Electrical Exhibition, Opening of the Vienna 518
Electrical railway, The 486
Electrical science, Progress in, in 1882 20
Electrical schools 308
Electricity and inventors 326
Electricity, Books for students of 53
Electricity, various applications of 148
Electricity, What is it? 342
Expert quackery 406
Going back to first principles 36
Gramme patent suit, The 518
Jay Gould on fools 486
Latest cable developments, The 52
Mho 390
Mutual Union trouble in Chicago, The 164
Ohm, The value of the 391
Old dynamos better than new ones 391
Our electrical agency 260
Postal Telegraph Company's expectations 422
Railroad light signals 374
Secondary battery, The theory of the 390
Some telephone yarns 196
Storage controversies 292
Strike, End of the 534
Strike, The 454, 470, 486, 502
"Subdividing the current," 260
Suggestions about working induction coils 309
Telegraph signals from mid-ocean vessels 422
Telegraph world during 1882, Review of the 37
Telegraphic competition 116
Telegraphic journalism 132
Telephone as a rival of the telegraph 100
Telephone consolidations 422
Telephone decisions, The 470
Telephone inventions 374
Telephone situation, The 438, 502
The end of King Coal 180
The march of electrical science 212
Underground problem, The 244, 261
Underground sleight of hand 358
Underground telegraphs 228
Underground wires 4
Use of dry piles as accumulators of electricity 438

THE TELEGRAPH.

Canadian cables 505
Exasperating results of sixpenny telegrams 468
First Morse telegram 372
Keys, Improvements in Morse telegraph 6
Morse code at sea 117
Mutual Union Company, Brief history of the 114
Ocean cables of the world 163
Postal telegraph, bill introduced 23
Postal telegraph company 150
Postal telegraphy discussed in the Senate 53
*Repeater, An improvement on Toye's 209
Steel wire for telegraph lines 151
Telegraph cables, Drawing and splicing the postal 469
Telegraph company, Mexican 54
Telegraph company, The Montreal 24
Telegraph company, Postal 504, 519
Telegraph companies, Responsibility for cipher messages limited 53
Telegraph consolidation, The latest 98
Telegraph in New Brunswick, The 21
Telegraph in the law courts, The 51, 70, 83
Telegraph line, The Canadian Pacific 468
Telegraph primer, The 505
Telegraph question, The Postal 503
Telegraph school, The Cooper Union 69
Telegraph wires in London 341
Telegraphers' Mutual Benefit Association 3, 521
Telegraphists, Lively Discussion in Chicago 101
Telegraphists' Reception in New York 102
Telegraphists, stenographers and journalists 51
Telegraphs 242
The Government and the telegraph 166
*Time Telegraph Company's system 289
*Western Union main office in this city 225
Western Union Telegraph Company, Jr 83
What an expert telegrapher does 469

THE TELEPHONE.

Telephone, Another claimant for the invention of the 505
Telephone cable in Chicago, Aerial 102
Telephone consolidation, The New England 517
Telephone companies, The New England 117
Telephone companies, New England, consolidating 467
Telephone Company, The Tropical American 102
Telephone Company, Trouble in the Secret 361
Telephone Company, Status of the Mexican 391
Telephone decision, The Boston 70
Telephone Exchange, Improvements in the Lowell, Mass 22
*Telephone Exchange, The Portland 323
Telephone, How to make a cheap mechanical 230
Telephone invention, The Patent Office decision on the 467
England and America, The telephone in 22
France, The telephone in 98
Telephone in Japan 18
Telephone in New England 82
Telephone in Portland, Maine 71
Telephone in Toronto 115
Telephone in Wisconsin, Progress of the 39
Telephone, latest developments of the 277
Telephone Lines, disturbances on 344
Telephone litigation in England 6
Telephone patent case, Status of the 99
Telephone, Progress in Ohio and Kentucky 392
Telephone, Progress in Canada 19
Telephone, The claims of Daniel Drawbaugh to the invention of the. 504
*Telephone, The first 423
*Telephone time service, Oram's 455
*Telephone transmitters, New 198
Telephone, Uncle Remus at the 99
*Telephone wire, A new 263
Telephone wire, Spiral 296
*Telephones, Improvements in 146
Telephonic experiments of a Russian government electrician 457
Telephonic peculiarities 5
*Telephonic repeaters, Bennett's 66
Telephoning at great distances 230
Telephoning, Remarkable long-distance 166
Telephony in Philadelphia 392
*Telephony, Long-distance 257
Telephony, Postal 277
Peculiar trouble in a telephone office 312
*Transmitting time by telephone 295
Will the telephone supersede the telegraph 227

THE ELECTRIC LIGHT.

Edison companies, Progress of the 5, 532
Edison Electric Light Company's work 392
Edison installation at Haverly's Chicag Theatre 243
*Electric candle regulator of M. Tommase
Electric light as an educator 66
Electric light abroad, The 345

INDEX TO VOLUME I.—Concluded.

Electric light challenge in Louisville.... 69
Electric light company in Chicago, A new.... 86
Electric light companies in convention, The Brush... 245
Electric light companies in litigation.... 391
Electric light controversy 53
Electric light for mines....456, 457
Electric light for the Brooklyn Bridge.... 118
Electric light "Freckle," Does the.... 115
Electric light in an insulated house.... 152
Electric light in California.... 312
Electric light in England, Progress of.... 242
*Electric light installation on board the Pilgrim ... 389
Electric light in the home.... 407
*Electric lighting (articles X. to XXXI. inclusive), 1, 17, 33, 49, 65, 81, 97, 113, 129, 162, 182, 199, 227, 241, 258, 274, 311, 324, 355, 405, 419, 435
*Electric lighting and locomotion 177-193
Electric lighting in London.... 468
Electric lighting in San Francisco 341
Electric lighting, Mr. Edison on.. 406
*Electric lighting on board ocean steamships.... 371
Electric lighting, Some points in.... 329
Electric light masts, The Los Angeles.... 291
*Electric light on board the ferry-boat Fulton 499
Electric light on the Brooklyn Bridge.... 326
Electric light on the new Fall River steamer.... 373
Electric light, Portable.... 359
Electric light, Promoting the.... 489
Electric light speculation at London.... 458
Electric lights at the London fisheries exhibition. 453
Electric light, The Edison.... 134
Electric light *vs.* gas in London.... 131
Fuller Electrical Company, Progress of the.... 134
*Incandescent lamps, Molecular radiation in.... 388
Why the lights go out.... 457

CORRESPONDENCE.

Aurora borealis.... 134
Competition in tickers.... 340
Conductivity of glass.... 71
Denver & Rio Grande Railroad.... 135
Embryo rival of Jay Gould.... 7
Favoritism a cause of poor train dispatching.... 54
Five railroad questions asked and answered.... 229
"Ghostly manifestations"—An explanation offered.... 23
Gramme Company and the underground question.... 295
Improved telegraphic quarters in St. Louis 54
Incandescent electric lights.... 119
Lighting the Elgin towers at Evansville, Ind.... 456
Morse alphabet, The proposed universal....23, 40
On the Mexican Central Railway.... 6
Phillips' sytem of telegraphic punctuation.... 7
Sanitary and other matters in the Chicago office.... 86
Signal Service, The 103
Signal Service, A good word for the.... 134
Simultaneous telephonic and telegraphic transmission 71
Suggestions for the new year.... 7
*Telephone matters in England.... 294
Telephone, The invention of the.... 441
Telegraphic labor problem.... 7
Telegraphing, The risks of.... 489
Telegraph relays, Sounds in.... 119
Telegraphy in Baltimore.... 7
Telegraphy in the Northwest.... 87
Universal alphabet, The.... 160
Wheatstone's automatic duplex system in America.... 214

POETRY.

A cruel deed.... 113
A plea for "professors".... 49
At the telephone.... 65
*Dynamo-Electric dangers.... 1
Johnny Bull to Jonathan.... 81
Jonathan to Johnny Bull.... 161
King Richard's barbecue.... 225
The charge of the lightning sender. 129
The rhyme on the block system.... 97
The "sending man's" dream.... 17
*The telegram 209
To Wheatstone.... 33

MISCELLANEOUS.

American electrical works clam bake, The.... 533
An anti-Gould cable scheme.... 22
Armatures and electro-magnets.... 312
Battery, A new open circuit.... 441
Battery, The Callaud.... 230
Battery, Prof. Gandini's improved.... 406
Batteries and electrical storage of power.... 440
Best place to seek shelter during an electric storm.... 521
*Bichromate of potash battery of M. Grouve.... 306
Bichromate of potash battery, Improvements in.... 327
Bolometer, The.... 53
Cable, The proposed new.... 485
Cable messages.... 408
Cable, Picking up the.... 439
Canceling postage stamps by electricity.... 343
*Cause of evident magnetism in iron, steel and other magnetic metals....360, 375
*Circuit breaker for electric clocks, M. Spellier's.... 307
Color of sound.... 278
*Communication in mines, rope wire-works, etc.... 209
Competition encourages invention.... 227
Connecting bells to clocks.... 377
Constructing a medical apparatus.... 378
Curious electrical phenomena.... 405
Decision in an annunciator case.... 134
Decisions in the Cameron and Gould, and Hatch suits. 3
Device for the execution of criminals.... 341
Dictionary, The imperial.... 407
Double induction motor.... 393
*Dynamo, Ball's "unipolar".... 273
*Dynamo, The new Siemens.... 304
*Dynamo-electric machines, Modern.... 531
*Dynamo-electric machines, Action and reaction of... 145
Dynamo-electric machines, Cast iron in.... 378
*Dynamo-electric machines, Modern.... 339, 371
Earth currents.... 277
Economy in electro-magnetism.... 151
Edison's opinion of electricity as a motor.... 405
*Edison's speed and pressure recording and alarm gauges.... 436
Electric cranks.... 295
*Electric gas lighting devices.... 421
Electric lighting, The steam engine in 534
Electric locomotive, The first.... 436
*Electric motor, A new.... 262
*Electric motor, M. Jablochkoff's new.... 67
*Electric motors, Historical.... 387
*Electric motors, Small.... 452, 467
Electric motors.... 377
Electric photographer interviewed, An.... 307
Electric railroad in Chicago.... 67
Electrical railway, The.... 533
Electric railway in Ireland.... 102
Electric railway company incorporated.... 294
*Electric railway at the Chicago Exposition.... 483
Electric railway in England.... 505
*Electric railway signals.... 515
Electric service in every day life....246, 278
Electric signal.... 325
Electric storms.... 309
*Electrical striking clock 533
Electric sun under the sea.... 457
Electric wonders of the age.... 405
Electrical culture.... 261
Electrical engineering 378
Electrical engineering, Another school of.... 296
Electrical engineering at the Massachusetts Institute of Technology.... 6
Electrical engineering at the Stevens Institute of Technology.... 436
Electrical exhibition at Konigsberg, Prussia.... 453
Electrical exhibition at Philadelphia.... 114
Electrical exhibition in Italy.... 293
Electrical features of the railway exposition.... 357
Electrical launch, Trial of a new.... 517
Electrical lines, Submarine.... 328
*Electrical photophore, The.... 307
Electrical railroad signals in England, New.... 51
Electrical resistance of the human body.... 440
*Electrical science, Fundamental principles of, 147, 165, 179, 195, 214, 243
*Electrical street cars.... 408
Electrical transmission of power.... 54
*Electricity as a time keeper.... 209
Electricity and aerostation.... 343
Electricity and its relation to the senses.... 277
Electricity, Dictionary of.... 69
Electricity generated in walking on a carpet.... 133
Electricity, Some advantages of.... 34
Electricity, Storage of.... 165
Electricity to supplant steam.... 469
Electricity *vs.* gas.... 214
Electro chemical paper.... 377
Electro dynamometer for very feeble alternating currents.... 404
*Electro-magnets, On winding.... 424
Electro-magnetic engines.... 393
Electro-magnetism explained, Some points on.... 152
Erratic electricity.... 488
Exigencies of the electrical trade.... 243
*Experimental demonstration of Ohm's law and other novelties, Prof. A. M. Mayer.... 34
Fire and police alarms, Philadelphia.... 488
Floods in the west.... 165
Franklin's lightning rod advertisement 279
French Academy prizes.... 277
Frictional electricity in machinery, An easy experiment to remove.... 147
Frictional electricity, Curious effects of.... 131
Government and the cable pool, The.... 38
Herr Hoorweg's thermic theory of the galvanic current.... 343
How high is the aurora?.... 130
Human body as a conductor, The.... 535
Incandescent light by a galvanic battery.... 330
Increase of electrical patents.... 279
Induction, On the various systems proposed to prevent the disturbing effects of.... 149
Ingenious machine for starting trains.... 167
Insulated wire, The manufacture of.... 457
International Exhibition at Vienna.... 166
Interview with Mr. Edison.... 85
Lamps and dynamo, New.... 85
Leclanché batteries, Deposits and overflow in.... 152
*Lightning arrester, A new.... 420
Lightning, How it feels to be struck by.... 488
Lightning's queer pranks.... 306
*Machine for covering wire.... 161
Magnetizing the meter.... 455
Maxim's exploit.... 408
M. Delaurier's new theory of the cause of production of hydro-electric and thermo-electric currents in batteries.... 342
Menlo Park.... 294
Meter, An explanation of the term.... 457
Microphones, The action of....5, 23
Microphone transmitter, M. Guerin's improved.... 357
*Microphonic contacts.... 310
*Motor, The "Electric Dynamic" small.... 519
*New "Ticker".... 6
New time system.... 391
New York Electrical Society....293, 325, 362
Ohm's law, The analysis of....420, 487
On a single formula for determining the insulation of a section of wire, measured through an intermediate lead.... 229
On the transformation of static electricity and of voltaic currents.... 118
Patent question, The.... 22
*Polar duplexes 469
Pneumatic tubes for postal business.... 424
Preparing to transmit electricity on a large scale.... 21
President and secretary of the T. M. B. A.... 19
Principal events in the electrical world in Germany... 66
Printing by electrolysis.... 522
Prof. Morton's lecture.... 263
Progress of electric railroad signals.... 166
Rapidity of the Leggo automatic system.... 313
Recent electrical storms.... 343
Registering policemen by electricity.... 312
Repair of wires broken close to glass insulators.... 230
Reporters on the lighting of the bridge, The.... 326
Result of an operator's carelessness.... 504
Return shock from lightning.... 439
Schools of electrical engineering.... 279
Secondary battery, M. Emile Regnier's.... 388
Secondary batteries and the electrical storage of power 404
Secondary battery decision, A.... 488
Signal service, The originator of.... 456
Signal service, Training for the.... 340
Signal service, The....39, 86
Shock from switch-board.... 230
Skeptics and electric railways.... 439
Storage batteries, Efficiency of.... 263
Strike, The great....471, 521
Strike of telegraph operators.... 451
Subdividing the current.... 312
Sun's heat the same as that of powerful electric arcs.. 455
Sun spots and earth currents.... 39
Table showing relative dimensions, lengths, resistances and weights of pure copper wire.... 258, 259
Telegraphic photography of the future.... 370
Telpherage.... 292
Testing the Chicago conduits.... 327
Thunder-storm in Washington and its effects.... 504
*Transmitting hand-writing by telegraph.... 230
Trouble with the Holz machine.... 330
Underground controversy in Philadelphia, The.... 407
Underground electrical conduit, Dorsett's.... 408
Underground electrical communication.... 532
Underground question, The.... 340
Underground question in court, The.... 406
Underground system, J. F. Martin's.... 359
Underground systems.... 274
Underground stockholder's meeting.... 312
Underground wires, Action of the New York Aldermen in regard to.... 70
Underground wires, A Philadelphia electrician on.... 362
Underground wires in the city.... 151
Underground wires in Chicago.... 85
Underground wires, Pneumatic tubes instead of.... 117
Vibrating armature of call bells.... 133
Vienna Electrical Exposition.... 263
*Western cut-off box.... 82
Western Union's iron-clad pledge, The.... 533
Western Union office in Detroit destroyed by fire.... 22
Western Union pneumatic system.... 373
Western Union, Still another suit against the.... 19
Western Union trouble in Pennsylvania.... 28, 39
Western Union's lucky find.... 50
Western Union wires in New York city to be put underground.... 54
Whitney's visitor.... 210
Winding electro-magnets.... 330
Winding and setting clocks by electricity.... 424

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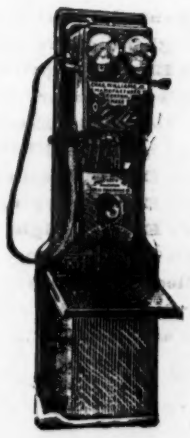

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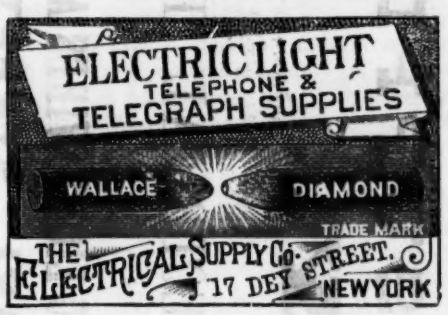

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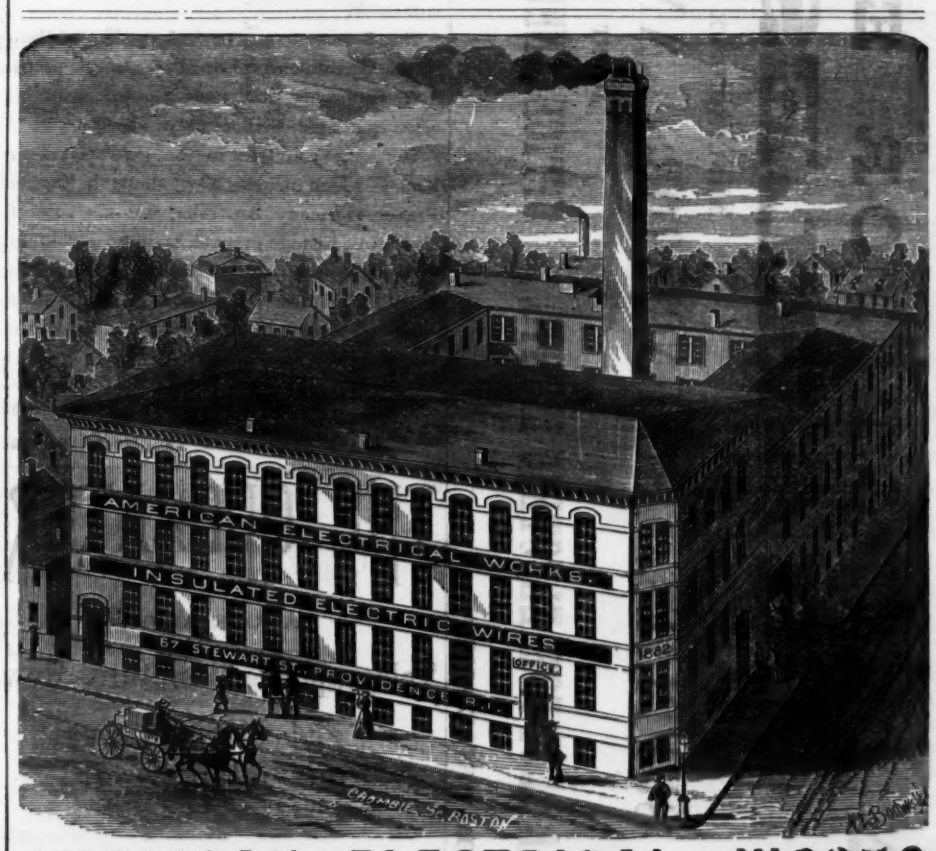

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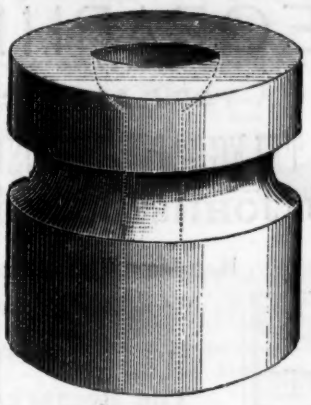

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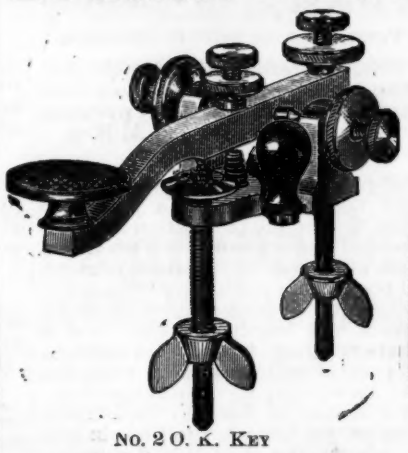

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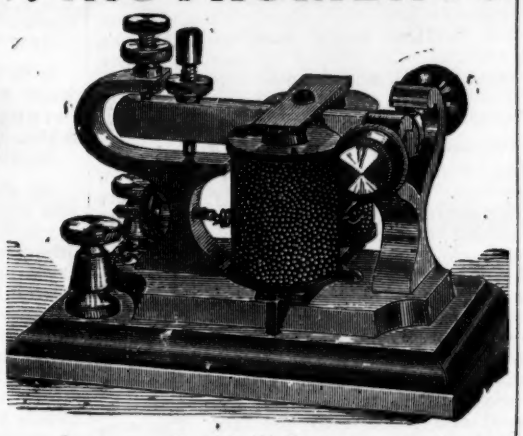

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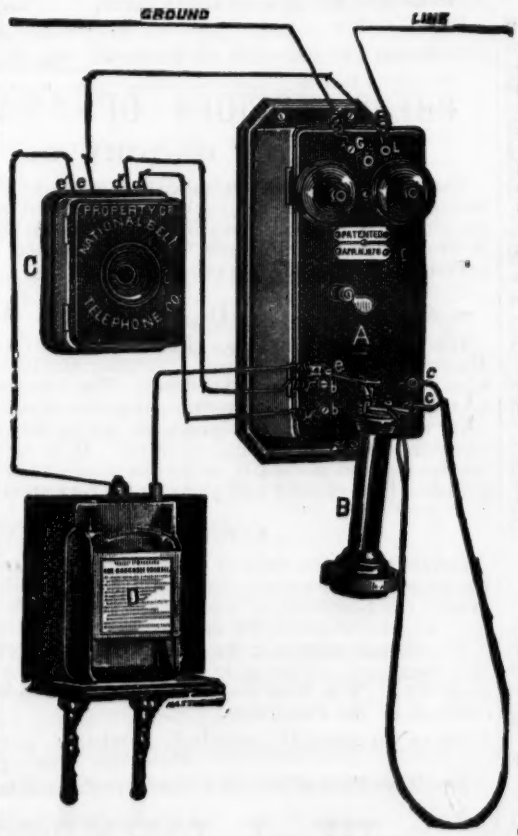

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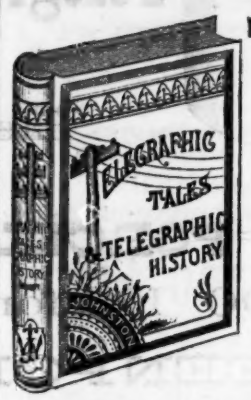

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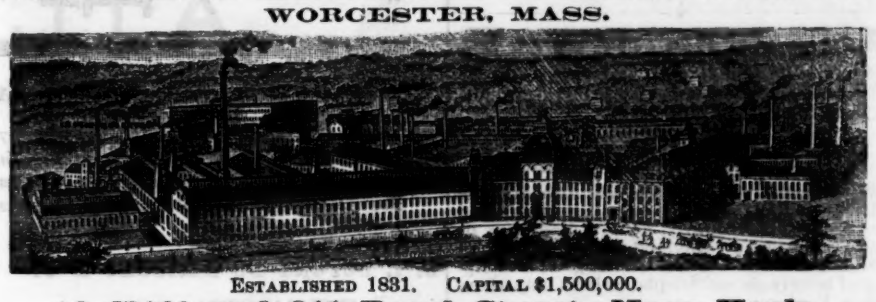

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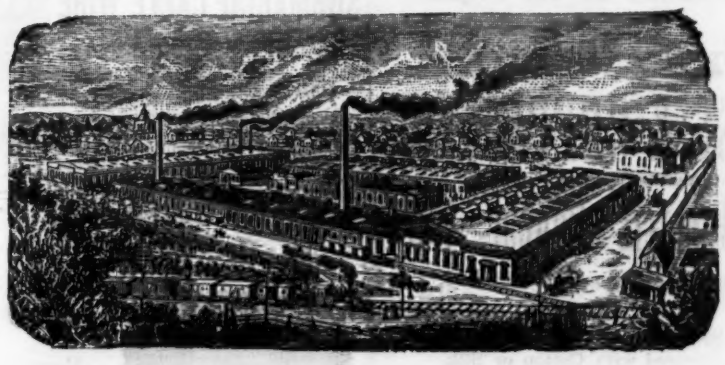

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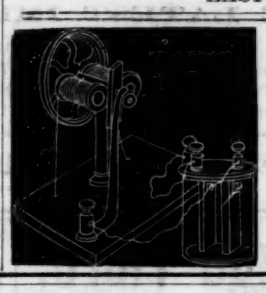

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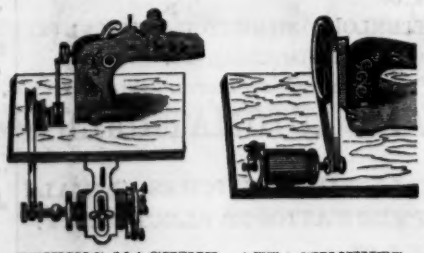

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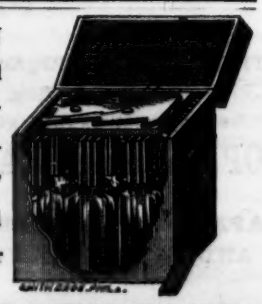

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